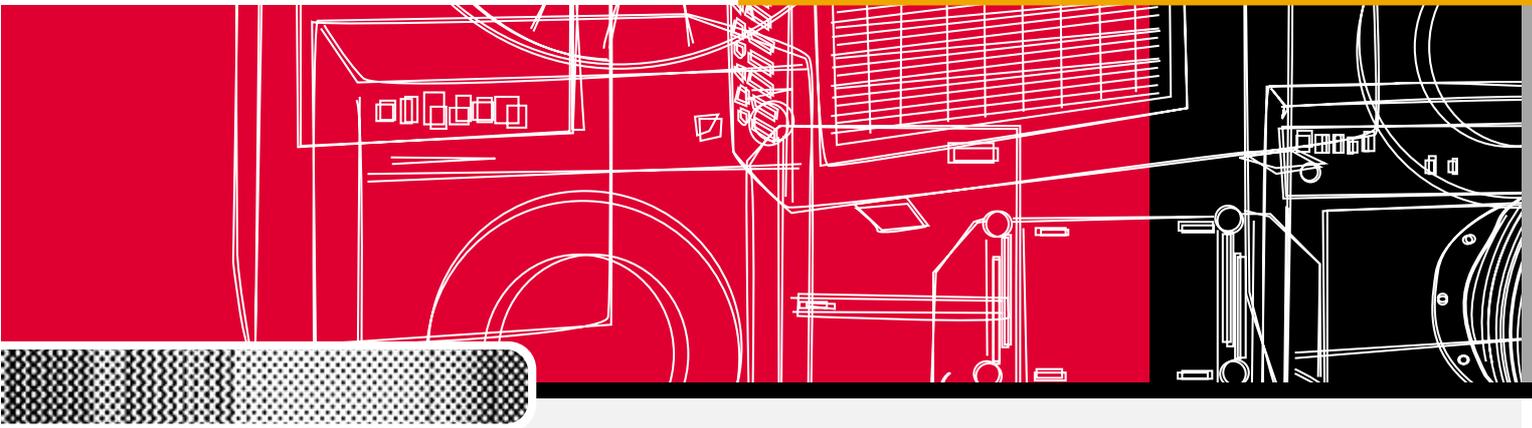


**NATIONAL APPLIANCE AND EQUIPMENT  
ENERGY EFFICIENCY PROGRAM**

**RESIDENTIAL STANDBY POWER  
CONSUMPTION IN AUSTRALIA**



AN AUSTRALIAN AND NEW ZEALAND MINERALS  
AND ENERGY COUNCIL INITIATIVE FORMING PART  
OF THE NATIONAL GREENHOUSE STRATEGY

**QUANTIFICATION OF RESIDENTIAL STANDBY  
POWER CONSUMPTION IN AUSTRALIA:  
RESULTS OF RECENT SURVEY WORK**

**Project for the  
NATIONAL APPLIANCE & EQUIPMENT ENERGY  
EFFICIENCY COMMITTEE**

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**Final Report**

**29 April 2001**

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May 2001.

## **NATIONAL APPLIANCE & EQUIPMENT ENERGY EFFICIENCY COMMITTEE MEMBER ORGANISATIONS**

The **Australian Greenhouse Office** is the lead Commonwealth agency for greenhouse matters. The Australian Greenhouse Office is responsible for overseeing the National Greenhouse Strategy in a cooperative effort with States and Territories and with the input of local government, industry and the community. An AGO officer chairs NAEEEC and others provide secretarial and project support for its activities.

The NSW **Ministry of Energy and Utilities** operates a regulatory framework aimed at facilitating environmentally responsible appliance and equipment energy use. The Ministry is represented on the ANZMEC Energy Management Task Force through which the appliance and equipment related elements of the National Greenhouse Strategy are being progressed.

The NSW **Sustainable Energy Development Authority** was established in February 1996 with a mission to reduce the level of greenhouse emissions in New South Wales by investing in the commercialisation and use of sustainable energy technologies.

The **Office of the Chief Electrical Inspector** is the Victorian technical regulator responsible for electrical safety and equipment efficiency. Its mission is to ensure the safety of electricity supply and use throughout the State. The corporate vision of the Office is to demonstrate national leadership in electrical safety matters and to improve the superior electrical safety record in Victoria. The Office's strategic focus is to ensure a high level of compliance is sustained by industry with equipment efficiency labelling and associated regulations.

The **Sustainable Energy Authority Victoria** is a state government agency with a charter to facilitate energy efficiency and the development and use of renewable energy to achieve environmental and economic benefits for the Victorian community and to contribute to the reduction of greenhouse gas emissions.

The Queensland **Department of Minerals and Energy** Electrical Safety Office has responsibility for energy efficiency initiatives in this state.

The Queensland **Environmental Protection Agency** is the lead agency for renewable energy and is also responsible for energy efficiency initiatives in this state.

The Western Australian **Office of Energy** seeks to promote conditions that enable the energy needs of the Western Australian community to be met safely, efficiently and economically.

The South Australian **Office of the Technical Regulator** seeks to ensure the coordinated development and implementation of policies and regulatory responsibilities for the safe efficient and responsible provision and use of energy for the benefit of the South Australian community.

The **Energy Efficiency and Conservation Authority** is an independent agency of the New Zealand Government charged with identifying and implementing practical measures to reduce energy consumption – “Helping New Zealand use energy wisely”.

NAEEEC also has, as members, the Tasmanian **Office of Energy Planning and Conservation**, the ACT **Department of Urban Services** and the Northern Territory **Department of Transport and Works**.

*The activities of NAEEEC are funded by the Energy Management Task Force. These bodies report to the Australian and New Zealand Minerals and Energy Council.*



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## Executive Summary

The use of energy by appliances and electronic equipment while not in use has not been comprehensively analysed or quantified in Australia in the residential sector. Of the studies that have been undertaken to date, it is estimated that around 10% of electricity consumed in households is attributed to appliances that are in “standby mode” while not performing their primary function.

For the purposes of this report, “standby” refers to a product or appliance that is connected to a power source but does not produce any sound or picture, transmit or receive information or is waiting to be switched “on” by a direct or indirect signal from the consumer. This includes the “off” mode, even where there is no remote control.

### Objectives of this Study

The Australian Greenhouse Office (AGO) and the National Appliance & Equipment Energy Efficiency Committee (NAEEEC) wanted to quantify the extent of residential standby energy consumption in Australia in order to provide a benchmark from which to evaluate a number of proposed NAEEEC programs which aim to influence standby energy consumption of new products.

In general terms, the objectives of the study were to:

- Quantify the magnitude of electricity used by appliances in standby mode Australia wide in the residential sector.
- Assess the current penetration of appliances using power in standby mode, together with historical changes and forecast trends to help identify key products and issues.
- Quantify the magnitude of electricity currently used by small appliances which do not strictly fall into the definition of “standby” but which are likely to contribute to miscellaneous energy consumption (small continuous appliances).
- Identify those product types with poor standby profiles and with current or forecast rapid growth that are likely to contribute to an increase in standby energy consumption within the residential sector in Australia.

### Research Methods

Several research techniques were employed for the study. In brief, they included:

1. An intrusive survey of 64 households: visits were made to 20 households in Melbourne, 24 households in Brisbane and 20 households in Sydney to conduct power measurements of all household appliances in off mode, standby mode and in-use (as applicable). Every plug load in each house was identified and measured where possible. Information about each appliance, such as age, brand name and model number was also collected.
2. An appliance ownership survey which involved telephone interviews with 801 respondents Australia wide. The purpose of the appliance ownership survey was to ascertain:

- The types of appliances present in households;
  - The age of those appliances;
  - Householder behaviour in relation to appliance usage (e.g. how appliance is switched off, how often appliance is in use, use of battery chargers, etc.)
3. Physical measurements of appliances in two major retail stores; one located in Brisbane and one in Sydney. In total 533 appliances were measured in order to augment data collected in the intrusive survey on current stock (i.e. sold in year2000/1).
  4. Analysis of historical metering data. In 1994 NSW Electricity utilities undertook an end use monitoring program in which half hourly data was recorded for the whole house and 8 separate appliances in 300 houses for around 1 year. The purpose of this data analysis was to produce an estimate of minimum house loads, excluding refrigeration and water heating appliances. This result was compared to the results obtained from the intrusive and telephone surveys in order for estimates in the growth of standby power consumption to be made.

## **Overall Results**

**Average standby and miscellaneous consumption was 86.8 Watts “as found” or 760 kWh per year per household. This includes small continuous loads.**

In Australia this equates to 11.6% of 2000 residential electricity use. Standby and miscellaneous electricity is therefore currently 5.3 Mt CO<sub>2</sub>-e.

Table 1 provides a summary of the in-use, standby and off readings for many of the appliances measured in the intrusive survey. It should be noted that these readings are stock averages. Where “N/A” is noted, either the data could not be collected because of disruption to the householder (for instance, measurements for computers which were on) or the reading was not applicable for that appliance (such as “off” measurements for clock radios, which are invariably always on and have no off switch), or the data was impractical, or impossible to obtain (as in the case of wired-in smoke detectors and stove and ovens). Ownership data for modems was not collected in the appliance use survey, therefore ownership data has been marked as “N/A”. Readings marked “N/A” under age denote that age data was not collected for these appliances in the appliance use survey. The data provided in Table 1 has been collated from various research techniques used in the study: the intrusive survey, store data measurements and the appliance use survey. The “on”, “standby” and “off” readings are obtained from the intrusive survey and store data, while saturation, penetration, ownership and mean age are obtained from the appliance use survey (and as such a significantly larger sample size).

Table 1 – Appliance mean on, mean standby, mean off, saturation, penetration, ownership and mean age

<b>Appliance</b>	<b>On (W)</b>	<b>Standby (W)</b>	<b>Off (W)</b>	<b>Saturation</b>	<b>Penetration</b>	<b>Ownership</b>	<b>Age</b>
Televisions	67.2	9.6	0.2	1.9072	99.6%	1.900	8
Clock Radios	1.4	N/A	N/A	1.7391	80.4%	1.398	N/A
VCRs	19.1	7.8	4.9	1.3553	89.0%	1.206	6
Stereos	11.7	9.5	1.3	1.4119	84.3%	1.190	8
Mobile Phone Chargers	6.2	1.2	N/A	1.5977	65.8%	1.051	2
Electric Kettles	N/A	N/A	N/A	1.0659	89.0%	0.949	4
Microwaves	N/A	3.9	0.3	1.0393	89.0%	0.925	7
Personal Computers	N/A	N/A	2.0	1.2783	57.4%	0.734	4
Smoke Detectors	N/A	N/A	N/A	1.9888	33.4%	0.664	N/A
PC Monitors	59.4	4.5	1.2	1.2418	53.2%	0.661	N/A
Printers	N/A	7.7	2.7	1.1505	51.5%	0.593	4
Speakers	N/A	3.3	2.1	1.2837	45.4%	0.583	N/A
Cordless Home Phones	3.6	2.7	0.9	1.0824	46.9%	0.508	N/A
Answering Machines	N/A	3.3	3.0	1.0405	40.1%	0.417	N/A
Electric Shavers	5.8*	0.6*	N/A	1.1387	34.2%	0.389	6
Play Station / Game Consoles	N/A	7.5*	1.2*	1.1907	26.8%	0.319	N/A
Plug in Air Fresheners	1.9	N/A	N/A	1.7442	16.1%	0.281	N/A
Dustbusters	N/A	1.3	N/A	1.0302	24.9%	0.257	N/A
Coffee Machines	N/A	0.8*	0.0*	1.0753	23.2%	0.249	7
Bread Makers	N/A	2.0	N/A	1.0115	21.7%	0.219	3
Electric Toothbrushes	N/A	1.6	N/A	1.2331	16.6%	0.205	2
Fish Tanks *	N/A	N/A	N/A	1.2185	14.9%	0.182	N/A
Fax Machines	N/A	8.2	0.4	1.0147	17.0%	0.172	5
Scanners	N/A	10.4	0.9	1.0397	15.7%	0.163	2
Laptops	18.7*	N/A	2.3*	1.1531	12.2%	0.141	N/A
DVDs	19.8	11.2	0.7	1.0909	8.2%	0.089	2
Digital TVs	N/A	N/A	N/A	1.1132	6.6%	0.073	N/A
Multi-Function Devices	N/A	9.1*	N/A	1.0426	5.9%	0.062	4
Photocopiers	N/A	N/A	N/A	1.0571	4.4%	0.047	4
Modems	N/A	5.7	1.7	N/A	N/A	N/A	N/A

\* Notes that the sample size contained less than ten valid readings

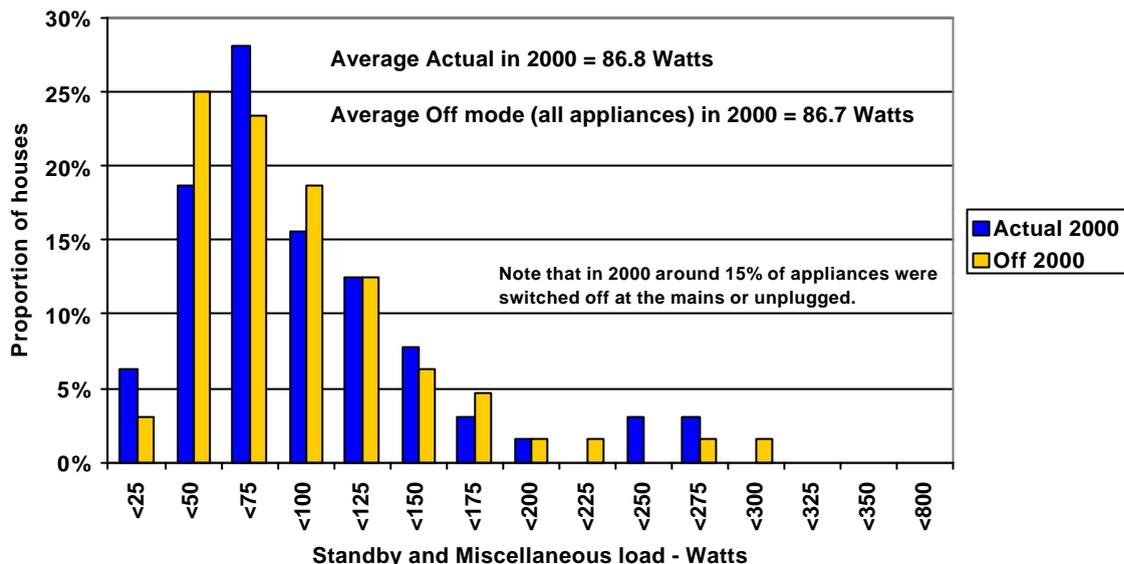
♣ Various components of fish tanks were measured, including filters, heaters, pumps and lights and any combination of these may be present in households. Therefore, a combined reading is not a practical indicator of on power consumption for fish tanks.

## General Findings

The following observations about householder behaviour in relation to the use of appliances were made using data obtained in the intrusive survey. The most notable findings included:

- **A small proportion (15%) of appliances were found “unplugged”.** However, data analysis revealed that if all appliances in households were plugged in but “off” (or in the lowest power mode) the average standby power remained about the same as illustrated in Figure 1 below.

Figure 1 – Residential Standby and Miscellaneous Electricity Usage in Australia (2000)



- **A large proportion of appliances were found to have power consumption in both standby and off modes.** Moreover, many products had no hard “off” switch. Such products included:
  - VCRs.
  - Computer peripherals such as speakers, modems, fax machines, scanning devices and printers.
  - Some small appliances such as breadmakers and a limited number of electric kettles<sup>1</sup>.
  - Many brands of audio and visual equipment (integrated stereos, DVDs).
  - An increasing number of white goods (in particular, those that incorporated “soft touch” electronic controls).
- **Computer peripherals (e.g. Scanners, modems, speakers) are a significant problem with regard to their use of energy off mode.**
- **Audio and visual equipment is an emerging concern and is compounded by the large number (average of 5) present in households.**

<sup>1</sup> Electric kettles weren’t measured as part of this study as it was initially believed that these appliance types would not have any standby usage. It has been found that this is not the case as some brands of electric kettles do have a small standby consumption.

## **Product Profiles**

The following provides an overview of the characteristics and observations made of the appliances measured in the intrusive survey.

### **Televisions**

- Television ownership is 1.9 per house and increasing.
- Fifty percent of televisions were found in “off” mode when not in use while 50% were in “standby” (switched off with remote control).
- Encouragingly, there has been a noticeable decrease in standby power (remote control off) since 1991, with the average standby falling from 16 Watts in 1991 to just over 5 Watts in 2001 (average 9.6W standby for all stock).
- Most TVs have a hard off switch with zero power consumption (0.2W off mode average).
- The average age of TVs was found to be 8 years.

### **VCR's**

- VCR ownership was found to be 1.21 per house and appears to be increasing.
- Very few VCRs have a hard “off” switch.
- The majority (89%) of VCRs were found in “standby” mode when not in use, only 11% were found in “off” (usually switched off at the wall).
- There has been a noticeable decrease in standby energy since 1990, with the average standby falling from 10 Watts in 1990 to about 4 Watts in 2001 (average 7.9W standby for all stock).
- Few VCRs were purchased prior to 1990. The average age of VCRs was 6 years.

### **Computers and Peripherals**

- Computer ownership was found to be 0.73 per house and appears to be increasing fast (penetration 57% of households).
- Monitors, speakers, modems and printers often have off mode consumption which is significant, many with up to 10 Watts or more in off mode.
- Most computers are less than 2 years old and few were purchased prior to 1996. The average age of computers was found to be 3.5 years (this is thought to be older than in the commercial sector).
- While many computers have a hard “off” switch, there are an increasing number of computers with a hot key start. As such, standby in off mode is likely to increase in computers.
- Average off mode consumption was as follows: computers 2.0W, monitors 1.2W, speakers 2.1W, modems 1.7W, printers 2.7W.

### **White Goods**

- Clothes washer ownership was found to be 0.95 per house. Ownership is considered to be saturated with very little or no market growth.

- Clothes dryer ownership was found to be 0.53 per house. As with clothes washers, ownership is saturated with little or no market growth.
- Dishwasher ownership was found to be 0.31 per house. Ownership is increasing slowly.
- Most white goods were found in “off” mode when not in use but with increasingly sophisticated electronics, power consumption in off mode is now common for most appliance types (except clothes dryers which is still less common).
- Average power consumption in off mode for white goods has increased since the late eighties (coinciding with the introduction of “soft touch” technology). The stock average for off mode was 2.0W for clothes washers, 0.5W for dishwashers and 0.4W for clothes dryers – all appear to be increasing.
- In use readings for dishwashers were hard to obtain as most were “built in” or difficult to move.

### **Microwave Ovens**

- Microwave oven ownership was found to be 0.93 per house. Ownership is saturated.
- Most microwaves are found in “standby” mode when not in use (with clock functioning). The stock average standby was 3.9 W (not decreasing).
- Some (few) microwaves come with a dial timer and have no clock function. Generally these types of microwaves used 0.0 Watts in off mode. Some new models with low standby are becoming available on the market.
- A high proportion (20%) of households switch off the microwave at the wall.

### **Mobile Phone Chargers**

- Mobile phone ownership was found to be very high at 1.05 per house.
- 31% of chargers were found in “standby” mode (plugged in and on but not charging) when not in use, 69% were unplugged or disconnected. The stock average standby was found to be 1.2 W.

### **Cordless Phones**

- Cordless phone ownership was 0.51 per house. Ownership is quite high, but trends are unknown (probably increasing).
- Most cordless phones are in “standby” mode (plugged in and on, fully charged) when not in use. The stock average standby was 2.7 W (not decreasing).

### **Fax Machines**

- Fax machine ownership was found to be 0.17 per house. Ownership is moderate and trends are unknown (possibly increasing, although email communication associated with the increasing number of households with internet access may slow fax ownership).
- Most were found to be in “standby” mode (plugged in and on waiting for a fax), with 27% only switched on as required. The stock average standby was 8.2 W (poor), but appears to be decreasing.

### **Clock Radios**

- Clock radio ownership was found to be 1.4 per house. Ownership is very high, and the market is likely to be saturated.
- All clock radios were found to be in “on” mode meaning that the time function was showing but the radio was off. The stock average in use was 2.1 W.

### **Answering Machines**

- Answering machine ownership was found to be 0.42 per house. Ownership is moderate, with the market probably saturated.
- Most answering machines were found in “standby” mode (ready to answer calls). The stock average standby was 3.3 W.

### **Dustbusters**

- Dustbuster or portable vacuum cleaner ownership was found to be 0.26 per house. Ownership is moderate and possibly increasing.
- Most were found in “standby” mode (battery charged but on). The stock average standby for dustbusters was 1.3 W (not decreasing).

### **Power Distribution Boards**

- Power Distribution Board ownership is high at about four per house. Most have no power consumption, although models with surge protection or lights consume some power. The stock average standby was 0.1 W.

### **Small Appliances**

- Include: breadmakers, coffee machines, fans, microwaves and rangehoods. Many small appliances were not measured such as irons, vacuum cleaners, hair dryers, toasters as most of these are zero Watts in off.
- Fans and rangehoods were found to have mostly 0.0 W off mode.
- Breadmaker ownership is increasing and they average 2.0W in standby.

### **Other Audio Visual Appliances**

- Include: stereo systems (all separate components and integrated systems), pay TV decoders and DVDs. TVs and VCRs are not included in this category.
- There are a large number of other audio visual appliances per household with the average being five per house.
- Appliances in this category had a very poor energy consumption profile in off mode and standby, many have no off mode.
- Nearly one third (32%) of appliances measured recorded standby of greater than 10 Watts. The average standby was 9.5 Watts and the average off mode (where present) was 1.3 Watts.
- There seems to be no improvement in consumption for appliances in off mode in recent years.

- No improvement in passive standby has been made in past ten years.

### **Battery Operated Appliances**

- Includes battery chargers of all types such as for electric toothbrushes and shavers, halogen lamps (with a LV switch), video cameras (note data includes dustbusters, mobile phone chargers & cordless phones which have also been examined separately). Ownership of battery operated appliances was high at 3.5 per house.
- Passive standby ranges from as little as less than one watt to less than 20 watts. The average standby was found to be 1.9 Watts.
- There has been no marked improvement in standby in recent years.

### **Continuous and Monitoring Appliances**

- Includes alarms, answering machines, clocks/clock radios, faxes, fish tank accessories, remote garage door openers, powerboards, mains powered smoke detectors (although none measured), surge protectors and timers (many been examined separately).
- There are a large number of such appliances per house with the survey finding 7.6 per house. Half of these were power boards.
- The average in use value for continuous and monitoring appliances was 3.5 Watts. If powerboard & garage openers were excluded, the average standby was 4.8W.

### **Cooking Appliances**

- Includes cook tops, ovens and combinations of all fuels. Virtually no readings were obtained, as most cooking appliances are “hard” wired.
- Most cooking appliances will have a standby (clock function) which is estimated initially at 3 Watts (more data is required).
- A limited number of gas ignition systems measured appeared to have no standby.

### **Water Heaters**

- Includes water heaters of all fuels with an electric connection. No readings were possible as most are “hard” wired.
- Electric water heaters are excluded, but gas water heaters with electronic ignition will have some standby, however, the amount of standby is not known.

### **Miscellaneous Appliances**

- Includes aerials, air fresheners, power tools (mains powered), heated towel rails, touch lamps & nightlights (for children), musical instruments (keyboards), fitness equipment, water pumps/fountains/filters/coolers.
- Miscellaneous appliances had an average off mode of 1.5 Watts. Standby was found to be 8.0W.
- Standby from miscellaneous appliances may be an emerging problem area, although not enough data was collected on product types to identify potential areas of concern.

## **Results of Analysis of Historical Monitoring Data**

NSW Electricity utilities undertook an end use monitoring program in 1994 in which half hourly data was recorded for the whole house and 8 separate appliances in 300 houses for around 1 year. Analysis of the data allowed an estimate of minimum house loads excluding refrigeration and water heating appliances. Results showed an average standby and miscellaneous consumption of 55.3 Watts (for households measured in 1994). The results exclude refrigerators and water heaters. A full report on the results was prepared by BRANZ on contract to the AGO in late 2000.

The growth in standby can be seen as significant when this result is compared to the year 2000 result obtained in this study, which showed that an average of 86.8 Watts were attributed to standby power (also excluding refrigerators and water heaters). The results imply an 8% per annum growth in miscellaneous and standby electricity consumption from 1994 to 2000 (i.e. doubling every 9 years). It should be noted that the current study and the BRANZ analysis are based on completely different methodologies, however we believe that the approach used in the most recent intrusive study is conservative and the growth may be even higher than originally estimated.

## **Conclusions**

- Results indicate that standby and miscellaneous power consumption in the residential sector is increasing at approximately 8% per annum, which implies that greater efforts need to be made to ensure appliance efficiency is improved.
- Programs to influence householder behaviour in relation to the use of appliances is not going to have a significant effect on standby power consumption, except for selected appliances such as TVs where there is still a substantial difference between standby and off modes. While consumers can be encouraged to continue to unplug and switch off appliances at the mains when not in use, this is not a very realistic basis for a communication campaign (inconvenient and any savings are not likely to persist).
- The largest long term savings will be achieved by reducing the standby and off mode power consumption of new appliances offered on the market.
- A large proportion of appliances were found to have significant power consumption in both standby and off modes. Greater use of hard “off” switches or better design of soft touch switches would help to reduce off mode consumption. VCRs, computer peripherals, some small appliances such as breadmakers and electric kettles, audio and visual equipment (particularly integrated stereo units) are the main offenders.
- Off mode power consumption is poor for some appliance types (white goods, audio and visual equipment) and this can mostly be attributed to poor product design.
- An increase in home computers and associated peripheral equipment coupled with the increase of home offices present a potential area of concern in terms of standby and off mode power usage.
- Audio and visual equipment (other than TVs and VCRs) are also an area for concern due to the large number per household and very poor off and standby performance of such appliances.

- While decreases in standby power were noted for TVs and VCRs (as compared to historical data), there is still room for improvement from these appliance types.
- Improvements in available technology such as integrated circuit switched mode power supplies means that there are now technical options to reduce standby consumption to very low levels for many appliance types. Policies need to be developed to bring new technology onto the market as soon as possible.



## Overview

### **Background**

Until this study was completed, the use of energy by appliances and electronic equipment while not in use had not been comprehensively analysed or quantified in Australia in the residential sector. Of the studies that have been undertaken previously, it had been estimated that around 10% of electricity consumed in households is attributed to appliances that are in “standby mode” i.e. while not performing their primary function.

### **Definition of “Standby”**

For the purposes of this report, “standby” refers to a product or appliance that is connected to a power source but does not produce any sound or picture, transmit or receive information or is waiting to be switched “on” by a direct or indirect signal from the consumer. This includes the “off” mode, even where there is no remote control.

Appliances and equipment with a “standby mode” may include: VCR’s, televisions, home entertainment systems, air conditioners, white goods (except refrigerators), battery chargers and any other equipment which consumes power while not performing its primary function. Standby also includes electrical power consumed by appliances that use other fuels as their primary energy source (eg gas water heaters or space heaters).

The number of these products present in households appears to be increasing rapidly. There is also a proliferation of office equipment in households such as computer equipment (and associated peripherals), cordless phones, answering machines and fax machines, all of which can have significant standby electricity consumption. Other appliances, such as the clock functions of certain appliances, smoke detectors and other monitoring appliances (alarms), consume small amounts of power continuously to perform their tasks, so while they do not strictly fall into the category of “standby”, it is clear that their energy consumption is equally important and could be reduced through improved design in many cases.

### **Study Objectives**

The National Appliance & Equipment Energy Efficiency Committee (NAEEEC), which is made up of federal and state government officials responsible for energy efficiency policy, wanted to quantify the extent of residential standby energy consumption in Australia in order to provide a benchmark from which to evaluate a number of proposed NAEEEC programs which will aim to influence standby energy consumption of new products.

In general terms, the objectives of the study were to:

- Quantify the magnitude of electricity used by appliances in standby mode Australia wide in the residential sector.
- Assess the current penetration of appliances using power in standby mode, together with historical changes and forecast trends to help identify key products and issues.

- Quantify the magnitude of electricity currently used by small appliances which do not strictly fall into the definition of “standby” but which are likely to contribute to miscellaneous energy consumption (e.g. small continuous appliances).
- Identify those product types with poor standby profiles and with current or forecast rapid growth that are likely to contribute to an increase in standby energy consumption within the residential sector in Australia.

## **Project Tasks and Outputs**

Several research techniques were employed for the study involving several interrelated tasks. In brief, they included:

1. An intrusive survey of households.
2. An appliance ownership survey.
3. Measurements of appliances in major retail stores.
4. Analysis of historical metering data.

Each of these is described in more detail below.

### **Intrusive Survey**

An intrusive survey of 64 households was undertaken with visits to 20 households in Melbourne, 24 households in Brisbane and 20 households in Sydney to conduct power measurements of all household appliances in off mode, standby mode and in-use (as applicable). Every plug load in each house was identified and measured where possible. Information about each appliance, such as age, brand name and model number was also collected. Some 3,296 measurements were undertaken.

### **Appliance Ownership Survey**

This survey involved telephone interviews with 801 respondents Australia wide. The purpose of the appliance ownership survey was to ascertain:

- Types of appliances present in households
- Age of those appliances
- Householder behaviour in relation to appliance usage (e.g. how appliance is switched off, how often appliance is in use, use of battery chargers, etc.)

### **Measurements of Appliances in Major Retail Stores**

Physical measurements of appliances were taken in a major retail store in Brisbane and in Sydney. In total 533 appliances were measured including: TVs, VCRs, microwaves, clothes washers, clothes driers, DVDs, stereo equipment, bread makers and dustbusters. The main purpose of conducting store measurements was to measure the standby consumption of current stock. The original project also envisaged that manufacturers would provide standby and off

mode power data on their current models for a wide range of products. However, there was only very limited response from manufacturers during the project.

### **Analysis of Historical Metering Data**

In 1994 NSW Electricity utilities undertook an end use monitoring program in which half hourly data was recorded for the whole house and 8 separate appliances in 300 houses for around 1 year. The purpose of this historical data analysis was to produce an estimate of minimum house loads excluding refrigeration and water heating appliances. To get a reliable sample, only data from about 120 households was used in the final analysis to estimate “baseload” or household standby power. This result was compared to the results obtained from the intrusive and telephone surveys in order for estimates in the growth of standby power consumption to be made.

### **Acknowledgments**

This report and the associated data analysis was prepared by Paula Kleverlaan of EnergyConsult and Lloyd Harrington of Energy Efficient Strategies. Field measurements on appliances in households were conducted by Kristina Sikich and Ruth Bongiorno on sub-contract to Energy Efficient Strategies. Data input forms were prepared by Paul Ryan of EnergyConsult. Test Research (a division of the Australian Consumers’ Association) generously provided a power analyser for the field measurements. Dianne Glass of Energy Efficient Strategies assisted with report formatting and preparation of feedback for the participating householders. The Australian Consumers’ Association through their subscriber magazine *Choice*, recruited participants for the intrusive survey from their readers and publicised the issue of standby with various articles.

Wallis Consulting Group undertook the telephone survey of 801 households on sub-contract to Energy Efficient Strategies.

The authors would also like to thank the 64 participating householders that were recruited by *Choice* magazine that volunteered for the intrusive survey and the store managers of Betta Electrical in Brisbane and Harvey Norman in Sydney who allowed new appliances to be measured *in situ*. The authors would also like to acknowledge the following manufacturers who voluntarily supplied power consumption data for a select number of appliances. They include: Yamaha Music Australia Pty Ltd, Philips Electronics and Matsushita Electric Company (Australia) Pty Ltd.

Members of the NAEEEC standby steering committee are also thanked for their guidance throughout the project.

## **Intrusive Survey**

### ***Aims & Objectives***

The primary aim of the intrusive survey was to measure the extent of products with a standby component in typical households in Australia.

### ***Approach***

The intrusive survey involved recruiting suitable participants from Melbourne, Sydney and Brisbane who were willing to be involved in the study and then visiting each household to conduct measurements of all appliances present within the household. Sixty four householders participated in the study. A detailed description of the selection process and methods is outlined below.

### ***Sampling Approach***

The sample was selected from households in Melbourne, Sydney and Brisbane. Melbourne and Sydney were chosen as a high proportion of the Australian population are located in these two cities. Brisbane was chosen to represent a smaller Australian capital city and to capture any climatic (or other) differences in appliance ownership. Household recruitment is described in detail the following section.

The sample size of 64 allows for a sampling error of  $\pm 12\%$  at a 95% confidence interval. While the sample size was not extensive, the results are still largely reliable for providing indications of standby power problem areas. However, it should be noted that where the sample of measurements for a particular appliance type becomes small (i.e. less than 20), results should be treated as qualitative only.

### ***Recruitment and Selection of Volunteer Households***

In order to recruit willing participants to be involved in the study, the Australian Consumers' Association, who participated on the project steering committee, agreed to place an advertisement in their Association magazine, *Choice* in October 2000. Respondents to the advertisement were required to contact the ACA to provide their address and contact name information. The magazine advertisement was augmented by various media (radio) segments with both ACA and AGO as facilitators in the media effort.

The sampling approach, while limited, aimed to solicit participants that as much as possible matched the typical Australian demographic spread in terms of household income, household ownership, housing type (i.e. detached household, attached household, flat or other), number of occupants and family type. Therefore, respondents to the advertisement were sent a short demographic questionnaire to fill in and return to ACA. The questionnaire also solicited the types of appliances present in the household to ensure that an adequate representation of selected appliance types was obtained. Respondents who returned completed surveys were entered into a prize draw of energy efficient appliances to encourage greater participation.

In total, 170 householders returned completed surveys. The low response rate (possibly attributed to the Sydney Olympics and the intrusive nature of the survey) was not ideal for selecting a sample that closely resembled the Australian demographic, particularly as the majority of respondents who returned completed surveys (68%) were from Victorian households. 14% (24 respondents) were from Brisbane and the remaining 20% were Sydney households. The high response in Melbourne was partly as a result of some radio coverage of the issue close to the time that the *Choice* article was published.

However, the sample still provides a good representation of the Australian demographic, with the following notable exceptions:

- A higher proportion of the sample were from flats.
- Household ownership was slightly skewed in that respondents living in rental houses were under represented.
- Couples with children were under represented in the sample. As a result, two person households were over represented in the sample.
- The sample over represented higher income groups (i.e. greater than \$50,000 annual household income).

The sample demographics are illustrated in Appendix B: Demographics of Appliance Use and Intrusive Survey on page 60.

## Preparation and equipment

The meter used for measuring appliance energy usage was borrowed from the Australian Consumers' Association. The meter used for the field measurements was a Yokogawa<sup>2</sup> power analyser Model 2504-99 (serial number 802).

Measurements were taken of all appliances within each participating household excepting appliances that were hard wired (e.g. door bells, smoke detectors, etc), or where measurements were not possible. Refrigerators were not measured to minimize the inconvenience to the householder (refrigerators do not have "Standby" as such in any case). Limited measurements were taken of some appliance types such as dishwashers as the power source was often located behind the unit and difficult to access within the time available. It was not possible to measure some equipment that was in use (such as computers) as it would have disrupted their operation.

Appliances were generally measured in-use, in standby (passive or active, where applicable) and off modes. Detailed information on all appliances was collected including:

- Model number
- Brand
- Year of purchase
- Hours of use

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<sup>2</sup> ACA NATA registration ID is 629.EL. The unit was calibrated on 20 July 2000. Uncertainty full scale 0.05% for power and current measurements.

- Status in which appliance was found (i.e. in use, standby or off, unplugged, hard wired)

In total 3296 measurements were taken during the survey. 2327 products were recorded and of those 1890 (81%) had power data measurements recorded in one or more of the above modes.

### Problems encountered during data collection

Not all products could simplistically be measured in-use, standby or off modes and in some cases, conditions on the definitions were applied to simplify analysis. Such appliances included:

- Mobile phone chargers and most battery operated appliances: for such appliances, in use was defined as “charging” while the “standby” reading was defined as the consumption from the charger only (i.e. the device/appliance not attached).
- Stereo equipment. Integrated stereo equipment was problematic in that standby power varied depending on the part of the unit “waiting to be used”. For example, standby could be higher for some units when a CD was present (but not playing) within the unit. To overcome the variation in standby measurements, measurements were taken of all possible functions of the unit (in standby) and an average taken of the measurements. Many stereo components did not appear to have an off mode.

In some instances, where an appliance power source could not be reached or where it was hard wired, data was not recorded (these are noted as “missing”). In such instances, to get a total standby power estimate for the home, any missing data is replaced with an average value for that appliance type as found in the rest of the sample.

### Comments on mode

Appliance use (the way it is turned off) has a significant impact on the amount of standby used. For example:

- If every appliance was connected in its lowest power mode, standby and miscellaneous consumption would have been 86.7 Watts per household.
- If consumers became “lazy” regarding their appliances and left things in standby mode where this was present, power consumption would be 147W (a 69% increase).

The intrusive survey results are based on the way the appliances were actually found during the intrusive survey.

## Results

Results indicate that earlier estimates<sup>3</sup> of standby energy consumption from households were reasonably indicative of the magnitude of standby power found in this study. This study found

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<sup>3</sup> EES 1999, *Study of greenhouse gas emissions from the Australian residential building sector to 2010*, prepared Energy Efficient Strategies for the Australian Greenhouse Office, Canberra, February 1999. ISBN 1876436 25X.

that, excluding water heaters and refrigeration appliances, **average standby and miscellaneous consumption was 86.8 Watts “as found”, or 760 kWh per year per household.**

In Australia this equates to 11.6% of 2000 residential electricity use. Standby and miscellaneous electricity therefore equates to 5.3 Mt CO<sub>2</sub>-e in 2000. This figure is probably increasing, although the exact rate is unclear (other analysis suggests an 8% per annum increase). Reasons for the increase include:

- An increase in the use of cordless phones, mobile phones and small appliances.
- Display features such as “aesthetically” lit displays in many integrated stereo systems.
- Increased electronics in major household appliances such as washing machines and clothes dryers.
- An increase in the ownership of computers and associated peripherals such as scanning devices, modems, speakers etc.
- An increase in the number of householders working from home under home office arrangements.
- Proliferation of small battery operated appliances and equipment and small gadgets that use transformer power supplies.

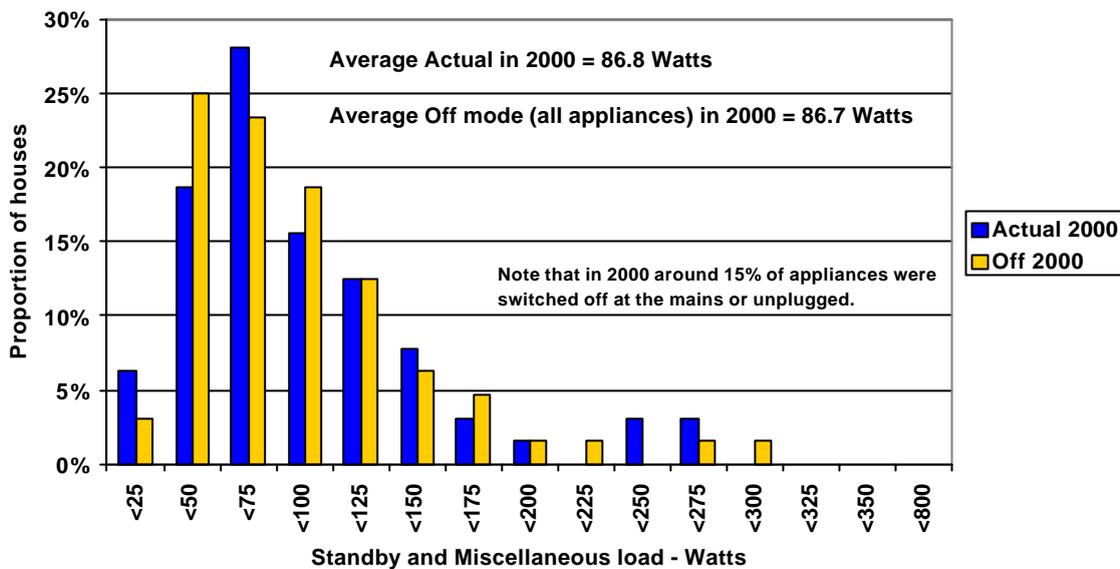
A small proportion (15%) of appliances were found “unplugged” in the intrusive survey. However, data analysis revealed that if all appliances were plugged in but switched “off” (or in the lowest power mode) the average standby remained about the same as when in standby (86.7 W). Figure 2 below illustrates the results.

This result can be explained by the following factors:

- Many appliances in standby are already in their lowest power mode
- Appliances found unplugged reduce the standby consumption in the “Actual 2000” data
- A small percentage of houses (2%) recorded an off consumption of between 275 to 300 Watts which will raise the average off consumption.

Note that this report does not include any stock modelling of the future impact of the findings of the surveys conducted for this study. NAEEEC may examine this issue in more detail once the initial results have been considered in detail.

Figure 2 – Residential Standby and Miscellaneous Electricity Usage in Australia (2000)



## Overview

A large proportion of appliances were found to have power consumption in both standby and off modes and many products had no hard “off” switch or consumed significant amounts of power in off mode. Such products included:

- VCRs.
- Computer peripherals such as speakers, modems, fax machines, scanning devices and printers.
- Some small appliances such as breadmakers and electric kettles<sup>4</sup>.
- Some brands of audio visual equipment, such as integrated stereo units.
- Clothes washers (particularly those that incorporated “soft touch” electronics).

Computer peripherals are an emerging problem with regard to their use of energy in standby and off modes. The problem is exacerbated by the rapid increase in household computer ownership (ABS data estimates that 54% of households had a computer in May 2000, an increase of 18% since May 1999<sup>5</sup>). In addition, the proportion of the population working from home is also increasing, resulting in a greater number of computers and computer peripherals present in homes. The appliance use telephone survey found that 20% of the sample worked from home

4 Electric kettles weren't measured as part of this study as it was initially believed that these appliance types would not have any standby usage. It has been found that this is not always the case and it has been found that at least one brand of electric kettle does have standby consumption.

5 Source: ABS *Australia Now: Communications and Information Technology – Household Use of Information Technology 2001*.

more than three days per week. ABS data shows that the number of home workers are increasing<sup>6</sup>.

In the case of audio visual equipment, the power consumption in off or standby mode is compounded by the large number present in households. The results showed that there was an average of five audio and visual appliances (not including TVs or VCRs) per house. It is unclear whether the total number is increasing.

## Product Profiles

The following provides detailed results for each appliance or appliance category. Appliance categories consisting of similar appliance types were created where appropriate to consolidate results and provide more statistical robustness to the results. Appliance types/categories include:

- Televisions
- VCRs
- Computers, peripherals and office equipment (such as computers, computer screens, laptops, printers, multi-function devices, scanners, CD writers, computer speakers, photocopiers, network devices (hubs/switches), external hard disk drives and backup devices and calculators.
- Clothes washers
- Clothes dryers
- Dishwashers
- Microwave Ovens
- Mobile Phone Chargers
- Cordless Phones
- Fax Machines
- Clock radios
- Answering machines
- Dustbusters
- Power distribution boards
- Small appliances (such as kitchen products (blenders, food processors, electric knives, juicers, coffee makers, bread makers, electric kettles, assorted electric cooking products, toasters), vacuum cleaners (portable and central) and fans (fixed and portable)
- Other audio visual (such as DVD players and recorders (but not computers or peripherals), set top boxes, digital/analogue signal conversion equipment, audio equipment (including all-in-one devices and separate audio components such as amplifiers, tuners, receivers, cassette decks, CD players etc.).
- Transformer and battery operated appliances (such as dedicated battery chargers, mobile phone chargers, cordless phones, fixed phones, portable battery operated

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<sup>6</sup> Source: ABS *Australia Now: Australian Social Trends 1995 – Work – Paid Employment: Home Workers*

- appliances (vacuum cleaners, torches), battery operated electric toothbrushes, battery operated electric razors, battery operated power tools (e.g. electric drills)).
- Monitoring and continuous appliances (such as answering machines, fax machines, clocks (separate clocks, clock radios, clocks on ovens or cookers), mains powered smoke detectors, household alarm systems, remote control systems (such as garage door openers), door bells, amplifiers/boosters for TV or radio signals, power indicator lights on a power board, surge protection devices and power filters, fish tank air pumps/filters).
  - Cooking appliances
  - Miscellaneous equipment (such as air filters, air fresheners, water filters, aromatherapy devices, radio transmitters, contact lens cleaners, tropical fish tank heaters, heated towel rails, ventilators, medical equipment, toys and fitness equipment).

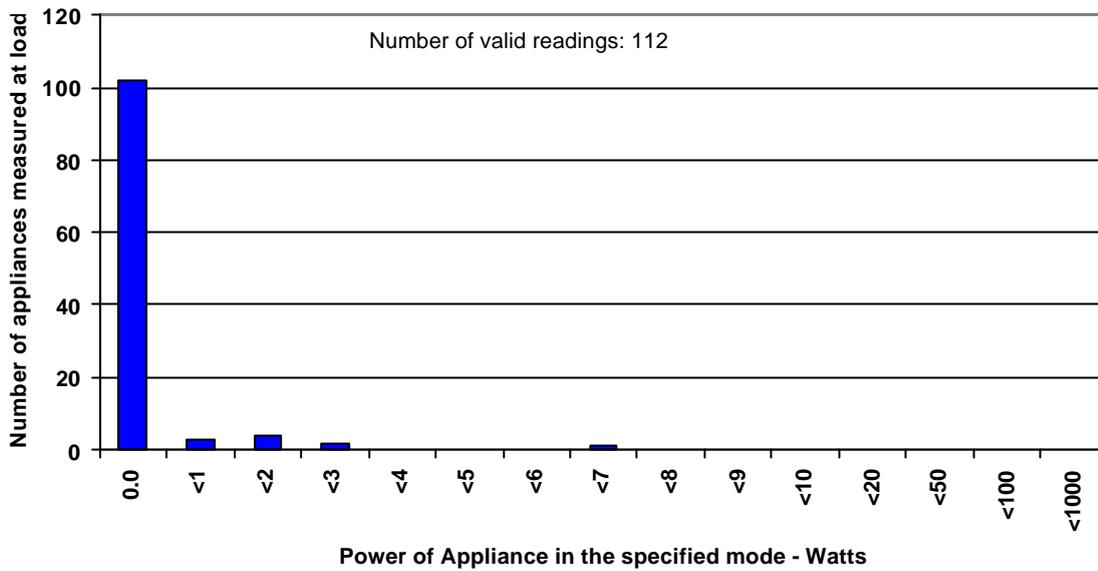
A full list of the product categories and products covered in the intrusive survey is shown in Appendix C.

### **Televisions**

Television ownership is 1.9 per house and is probably still increasing. Most TVs were found to have a hard “off” switch and when “off” power consumption was usually zero Watts. Some televisions have only a standby mode with no hard off switch. Older TVs were usually found to have no standby mode (prior to remote controls, mostly prior to 1990). Fifty percent of televisions were found in “off” mode when not in use while 50% were found in “standby” mode. Encouragingly, there has been a noticeable decrease in standby power consumption for units made in more recent years. The stock average was found to be 9.6W (0.2W off) in 2000. The average age of TVs was found to be 8 years.

Figure 3 indicates that the vast majority of TVs have zero energy consumption when in off mode. Figure 4 shows that the average energy consumption for TVs in off mode has been zero since 1998.

Figure 3 - Power measurements for TVs: Off Mode



Note: All histograms included in this report use the same bin definitions. The first bin indicates the number of units with no power consumption in the mode specified (i.e. equal to 0.0 Watts). The second bin is the number of appliances with >0.0 Watts but less than 1.0 Watts. The third bin is the number of appliances with greater than or equal to 1.0 Watts and less than 2.0 Watts and so on. Note that bin sizes for >10 Watts are non linear.

Figure 4 - Power consumption for TVs: Off Mode

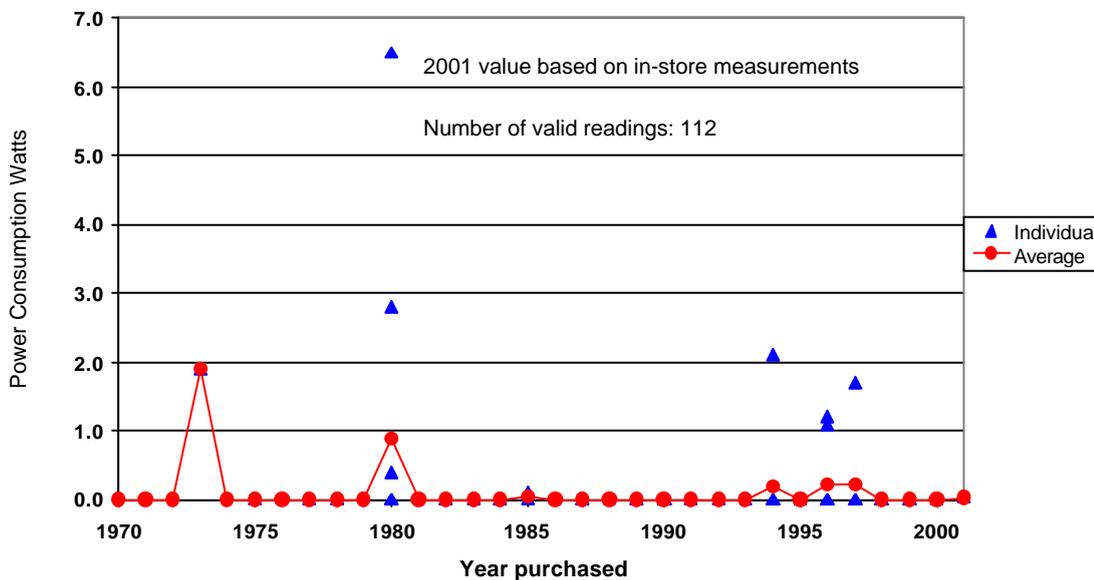


Figure 5 illustrates that a high proportion (38%) of TVs in the sample recorded passive standby measurements of between 10W and 20W. Twenty percent of the sample recorded a passive standby reading of less than 5W, which is indicative that greater improvements to passive standby consumption for TVs can still be made.

Figure 5 - Power Measurements for TVs: Passive Standby

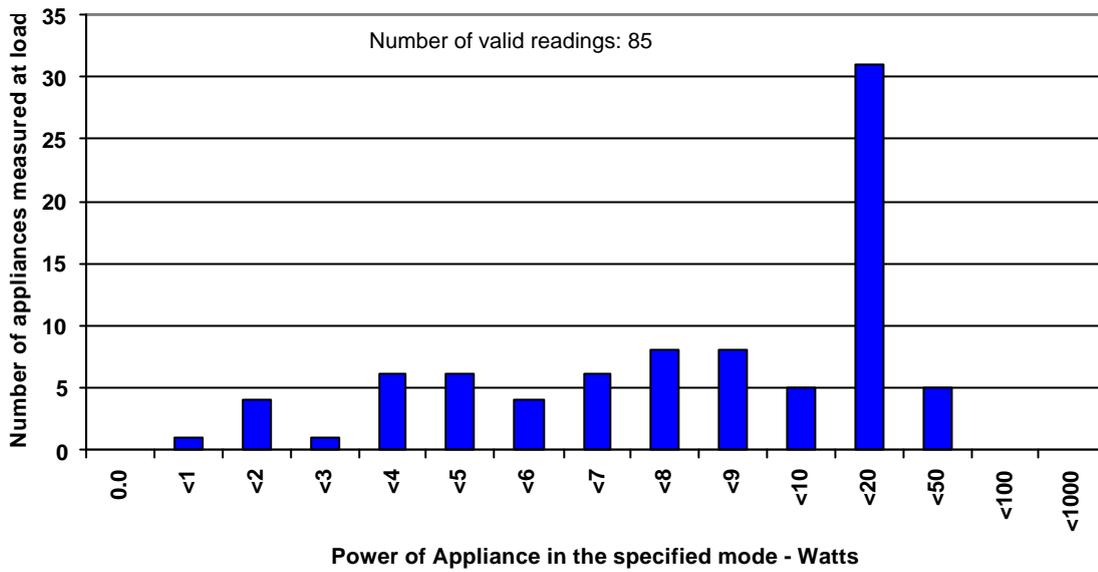
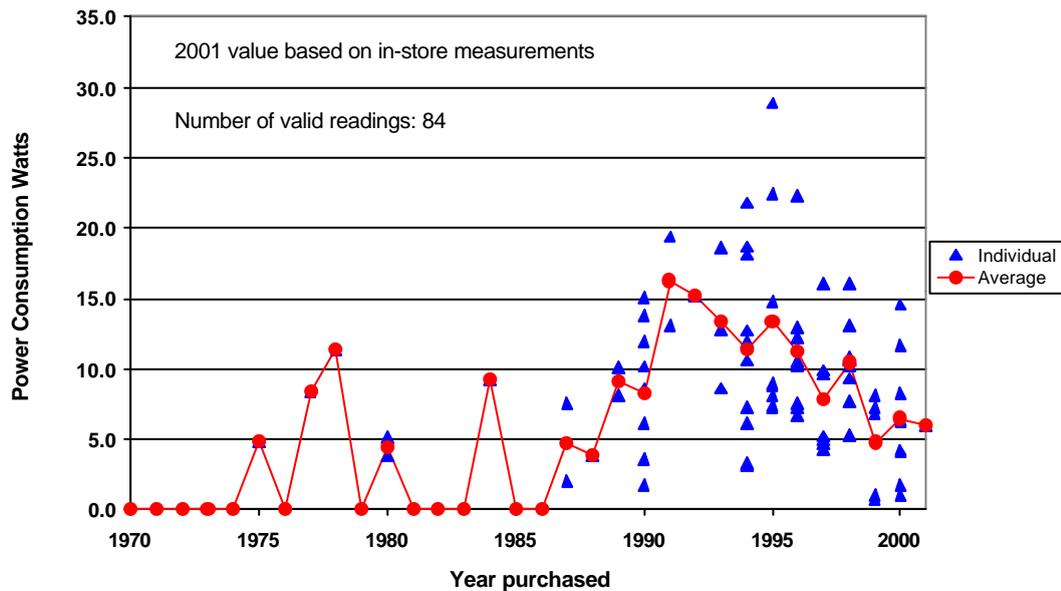


Figure 6 shows a decrease in the average passive standby for TVs since 1991 (notably, a marked increase in passive standby occurred in the late eighties as the proportion of units with remote controls increased in the stock). The average passive standby for TVs in 2001 was 6W, based on 150 measurements undertaken in major appliance retail stores. It is interesting to note that there were a number of units in the stock (1999 and 2000 cohorts) that had low standby values of 1.0 Watt or less. The most advanced units now available on the market now have a standby of 0.1 Watt or less. About 20% of new TVs measured in retail outlets in late 2000 were already at less than 1.0 Watt on standby.

Figure 6 - Power consumption for TVs: passive standby



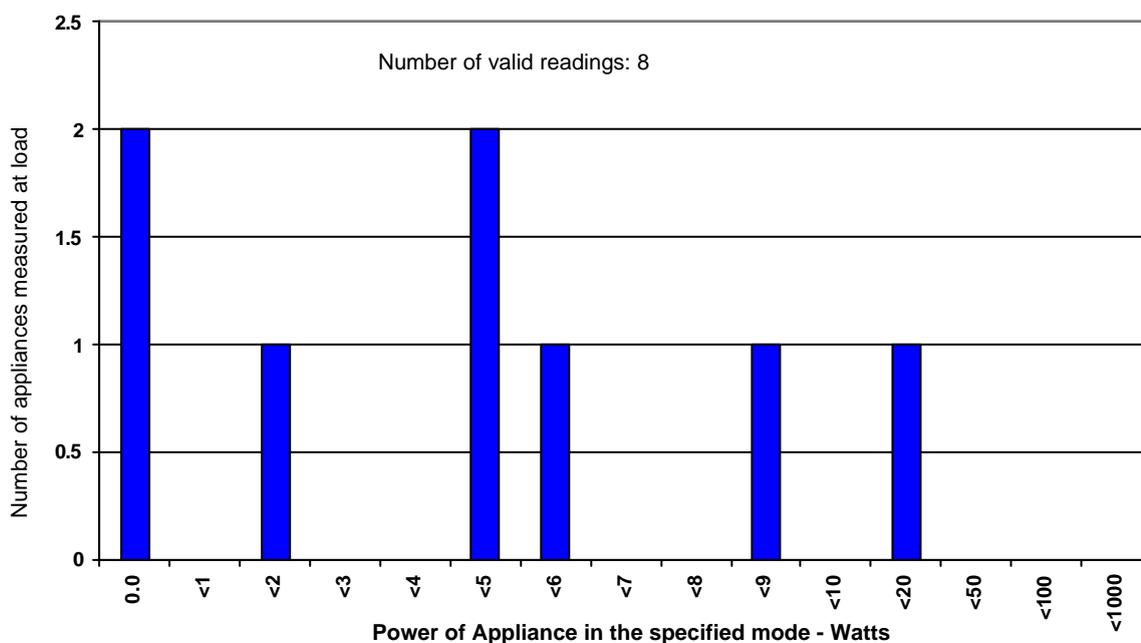
The average size of televisions installed in 1975 was about 40cm (based on a linear regression) and by 2000 this had increased to 52cm (an increase of 0.47cm per year). The average size on display in retailers in 2001 was 63cm, but this was skewed somewhat by a significant number of large LCD, rear projection and plasma screen models (none of these were found in the intrusive sample). Average in-use power consumption for televisions in 1975 was 60 Watts (based on a linear regression) and by 2000 this had increased to 70 Watts (an increase of 0.35 Watts per year). There is no obvious or strong trend to suggest that TV energy efficiency in-use is improving or deteriorating markedly (the in-use size-power slope for the stock was similar to 2001 models; small TVs (34cm) used about 2 Watts more in 2001 and larger TVs (68cm) used about 5 Watts more in 2001, based on a linear regression for both data sets). A couple of plasma screen models had very high in-use power consumption (of the order of 300 Watts). No LCD models were measured.

### VCR's

VCR ownership was found to be 1.21 per house and appears to be increasing. Very few VCRs have a hard "off" switch. The majority (89%) of VCRs were found in "standby" mode when not in use; only 11% were found in "off" (in most of these cases they were switched off at the wall or unplugged). There has been a noticeable decrease in standby energy since 1995; the stock average standby was 7.9W in 2000. Few VCRs were found to be older than 1990. The average age of VCRs was 6 years.

The number of readings for VCRs in off mode were very limited and as such it is difficult to report any useful trends or to provide any indication of the magnitude of energy consumed by VCRs in off mode (total of 8 readings – most VCRs do not have an off mode). Figure 7 illustrates the results.

Figure 7 - Power measurements for VCRs: off mode



In contrast, Figure 8 illustrates that in passive standby mode, a high proportion (84%) of VCRs in the sample consume more than 5W. Figure 9 shows that the average passive standby for VCRs has decreased since 1992, which is a positive result. However, recent improvements in VCR power supplies mean that there are still significant gains to be made – the most advanced designs available can now achieve a standby of less than 1.0 Watt, although these are yet to appear on the Australian market. The average passive standby for VCRs in 2001 was 3.8W, based on 41 measurements undertaken in major appliance retail stores. A number of new VCRs measured in retail outlets in late 2000 were already at around 2.0 Watts or less on standby, although none this low were encountered in the intrusive survey (lowest was 3.1 Watts).

Figure 8 - Power measurements for VCRs: passive standby

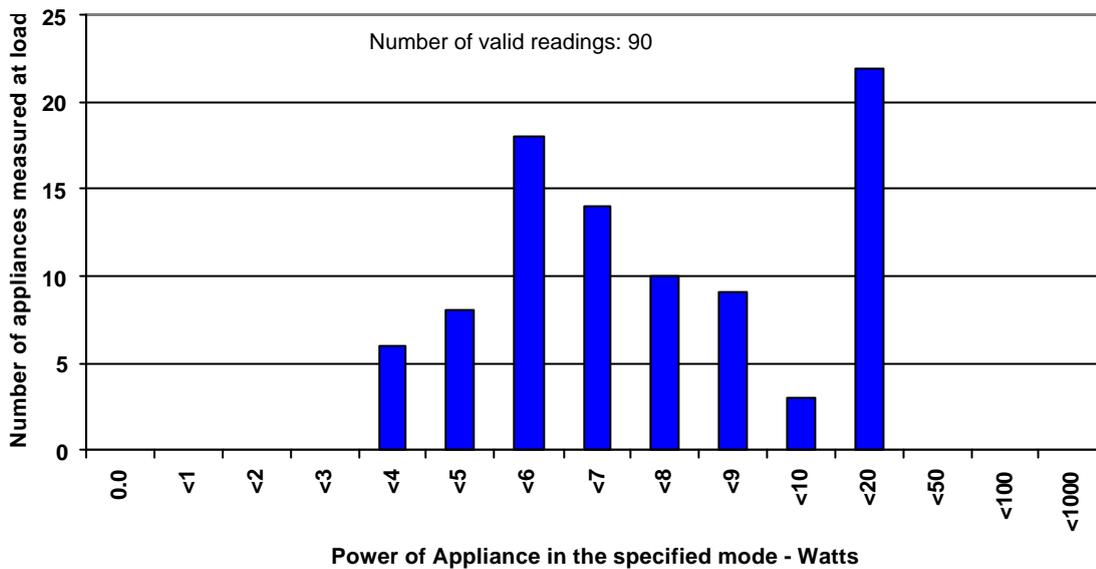
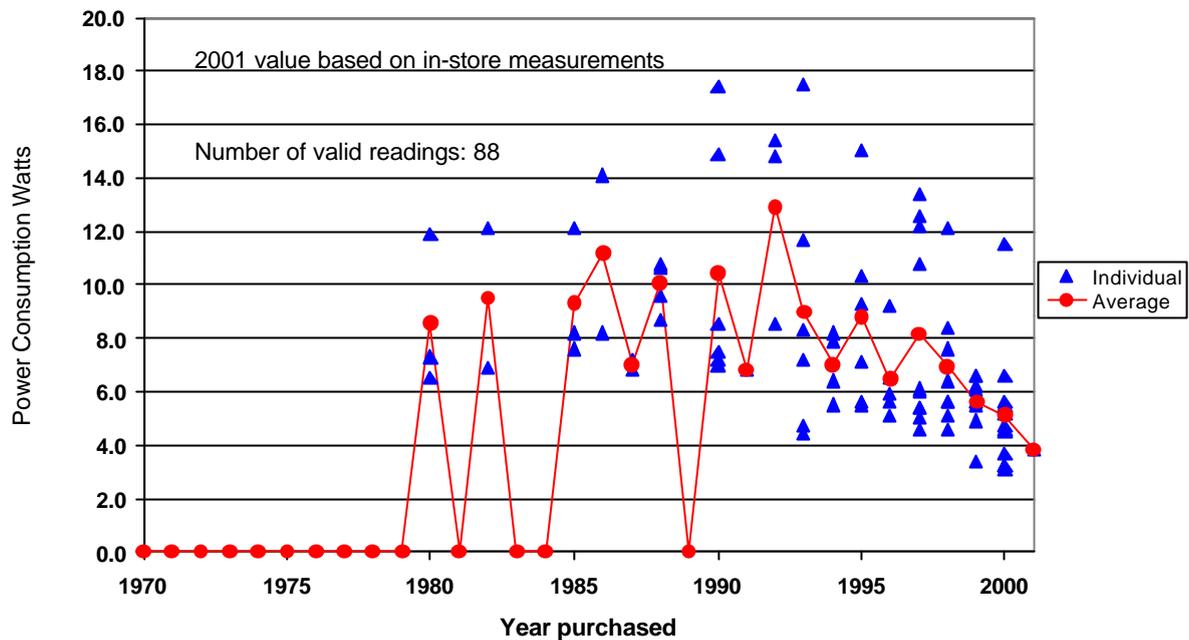


Figure 9 - Power consumption for VCRs: Passive Standby



### Computers and Peripherals

Computer ownership was found to be 0.73 per house and this appears to be increasing fast. The intrusive survey found that monitors, speakers, modems and printers often have significant off mode consumption. Most computers are less than 2 years old and fewer were found to be purchased prior to 1996. The average age of computers was found to be 3.5 years. This is probably older than the average age of computers in the commercial sector.

Figure 10 illustrates that just over half (52%) of computers measured in the sample recorded an off reading of zero watts. While many computers have a hard “off” switch, there are an increasing number of computers with a hot key start with some off mode power consumption. As such, standby in off mode in computers also appears to be increasing and Figure 11 illustrates this trend, noting that the 2001 value is zero because no in store measurements were included in the data set.

Figure 10 – Power measurements for computers: off mode

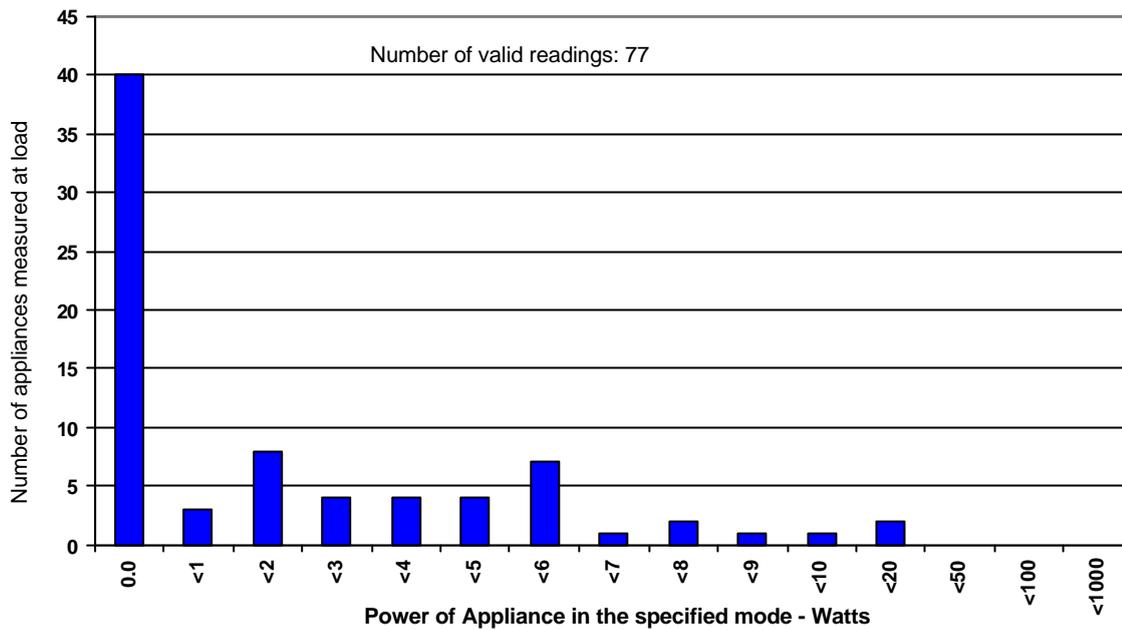
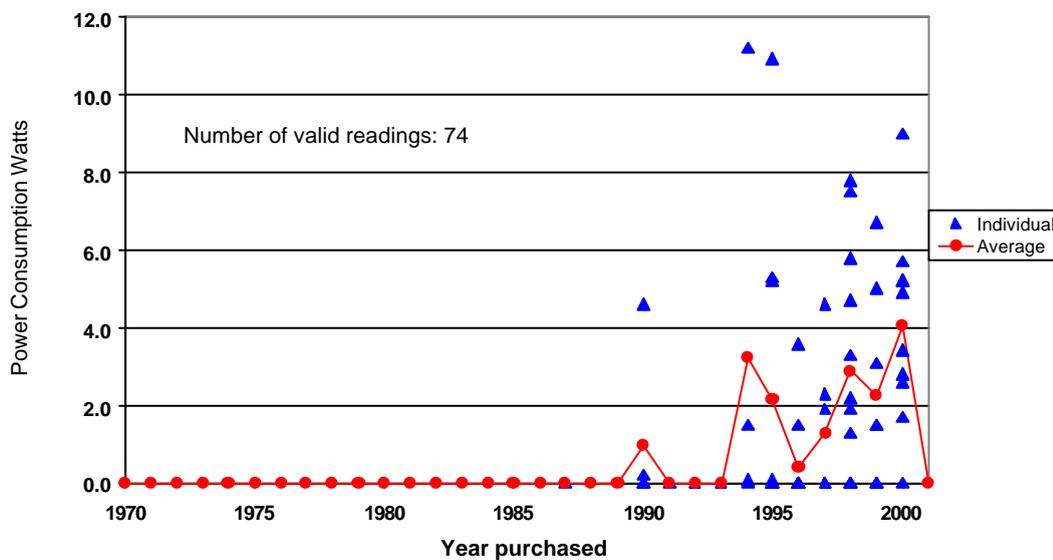


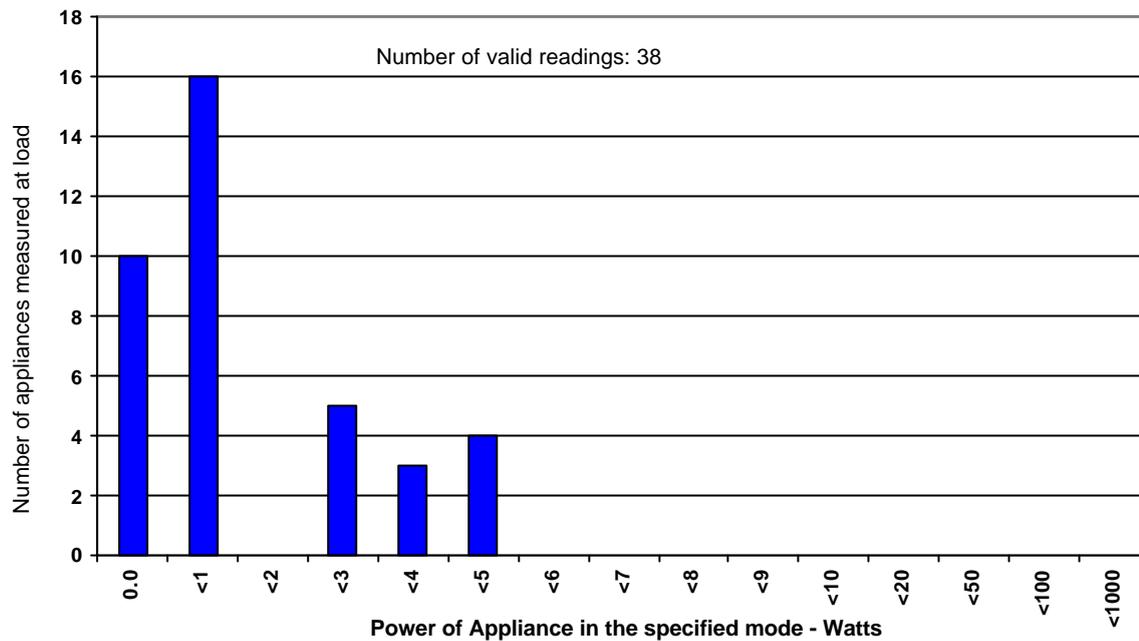
Figure 11 – Power consumption for Computers: Off Mode



Note: 2001 value is zero as store measurements are not included in the data set.

Nearly three quarters of computer monitor measurements taken in off mode revealed readings of greater than 0.0 watts, although nearly half (42%) recorded readings of less than 1 watt. It should be noted that the number of valid readings is small (n=38), therefore results should be treated with some caution. Figure 12 illustrates the results.

Figure 12 – Power measurements for computer monitors: off mode



Consumption of energy from computer speakers in off mode was poor, as illustrated in Figure 13 below. Again, the sample size is small, therefore results are only indicative.

Figure 13 – Power measurements for computer speakers: off mode

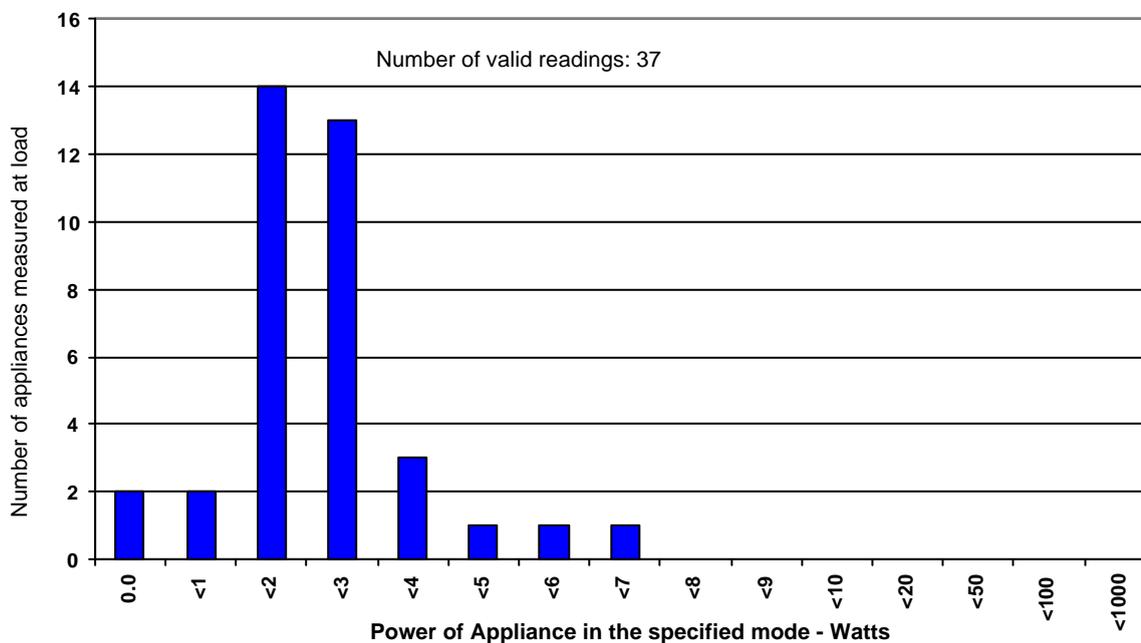
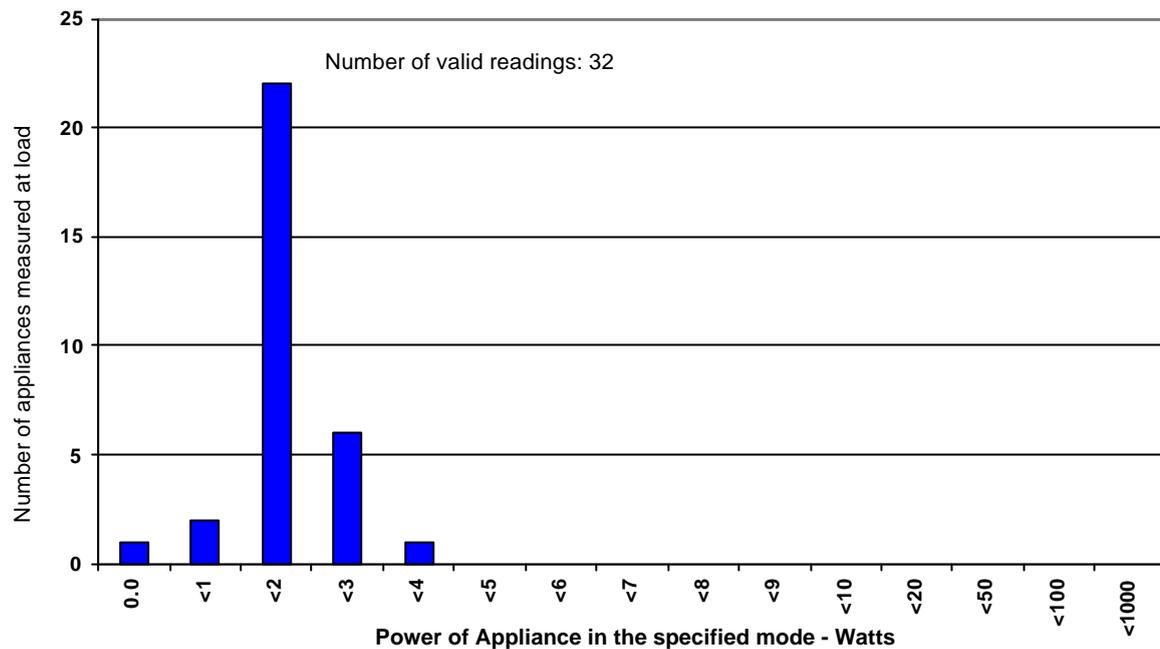


Figure 14 shows that the majority of modems measured had an off reading of greater than 1 Watt, with a high proportion recording a reading of around 2 Watts. In most cases this is primarily the standing no load loss of the transformer power supply.

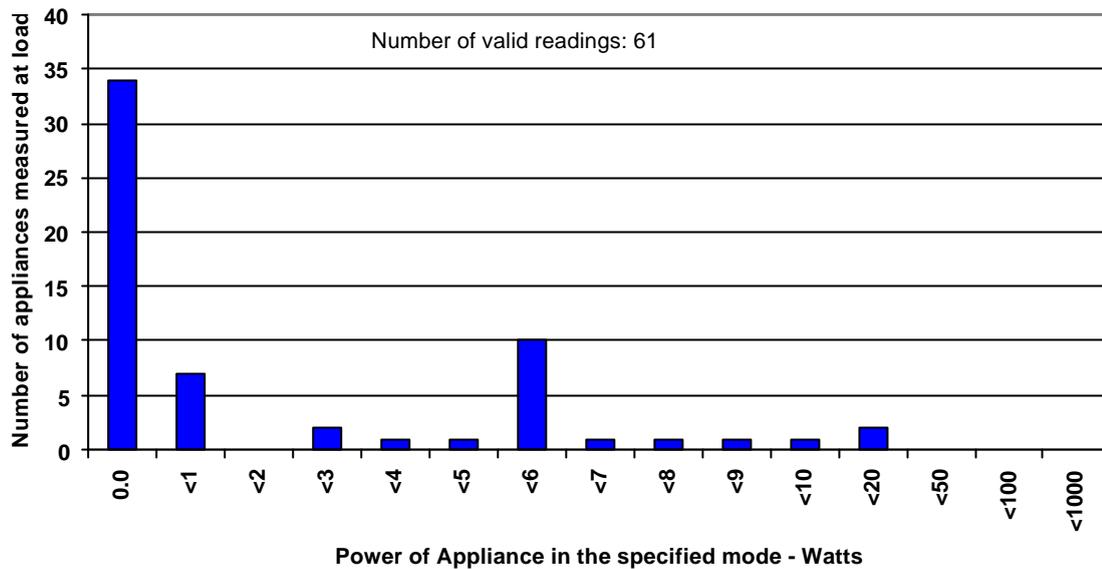
Figure 14 – Power measurements for modems: off mode



### **Clothes Washers**

Clothes washer ownership was found to be 0.95 per house. Ownership is considered to be saturated with very little or no market growth other than from new household formation. Almost all clothes washers were found in “off” mode when not in use but with increasingly sophisticated electronics, standby is common meaning that there can be significant energy consumption in off mode for some models. Figure 15 shows that just over half (56%) of all washing machines measured had an off reading of zero watts – many of these are older machines.

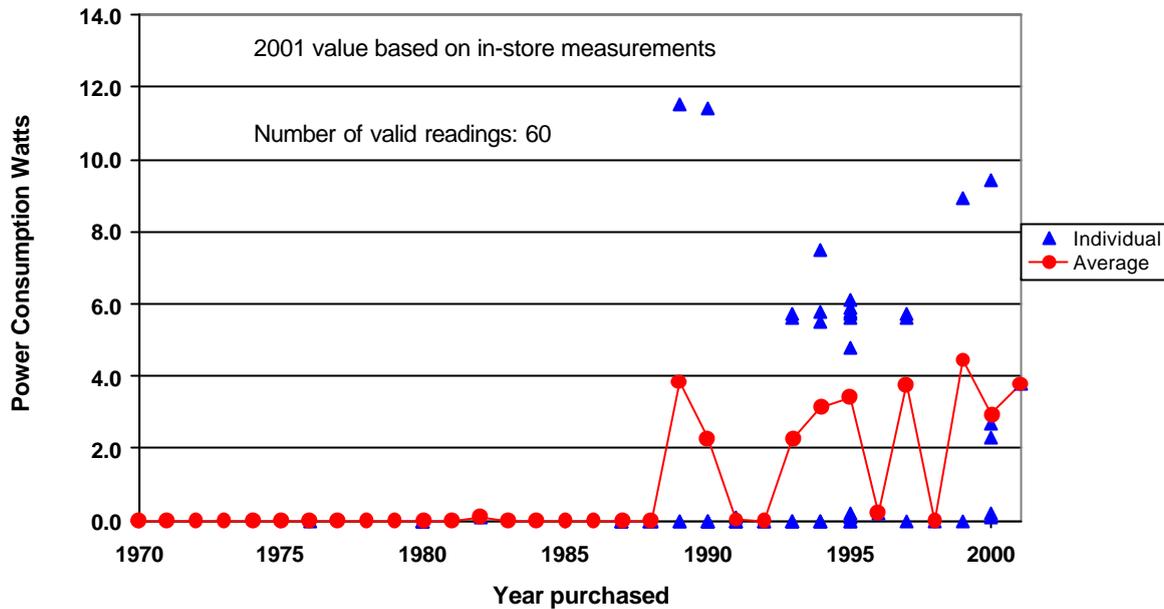
Figure 15 - Power measurements for clothes washers: off mode



One particular local brand was prominent in standby measurements. However, to conduct the field measurements, it is necessary to disconnect the power and reconnect it through the power analyser. Apparently, for this particular brand, when power is reconnected, the system actively monitors for a water level increase in the machine (which could be due to a faulty tap or solenoid) for a period of about 30 minutes – during this period the off mode consumption can appear to be higher than its normal background level (this effect has not been confirmed with further testing as yet). This demonstrates the importance of undertaking tests under controlled conditions in a laboratory and the possible pitfalls of taking measurements on machines with complex control software (where this is not understood). Because of this problem (which was not known when the field readings were undertaken), the estimates for clothes washers may be higher than actual off mode levels in the field.

Figure 16 below illustrates how the average off mode power consumption for washing machines has increased since the late eighties (coinciding with the introduction of “soft touch” technology in clothes washer electronics). The stock average for off mode is 2.0W and looks to be increasing.

Figure 16 - Power consumption of washing machines: off mode



**Clothes Dryers**

Clothes dryer ownership was found to be 0.53 per house. As with clothes washers, ownership is saturated with little or no market growth. Almost all clothes dryers were found in “off” mode when not in use. Electronics in dryers are still relatively uncommon in Australia but their use is becoming more frequent. The stock average off mode was found to be 0.4W, but this also appears to be increasing. Figure 17 shows that the majority of dryers measured had off readings of zero watts.

Figure 17 – Power measurements for clothes dryers: off mode

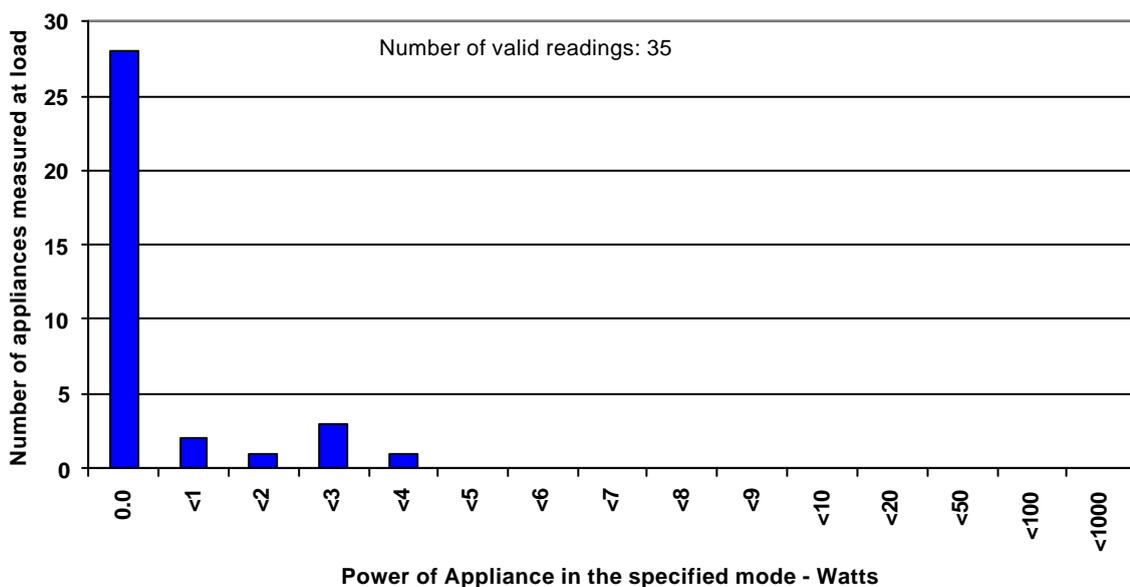
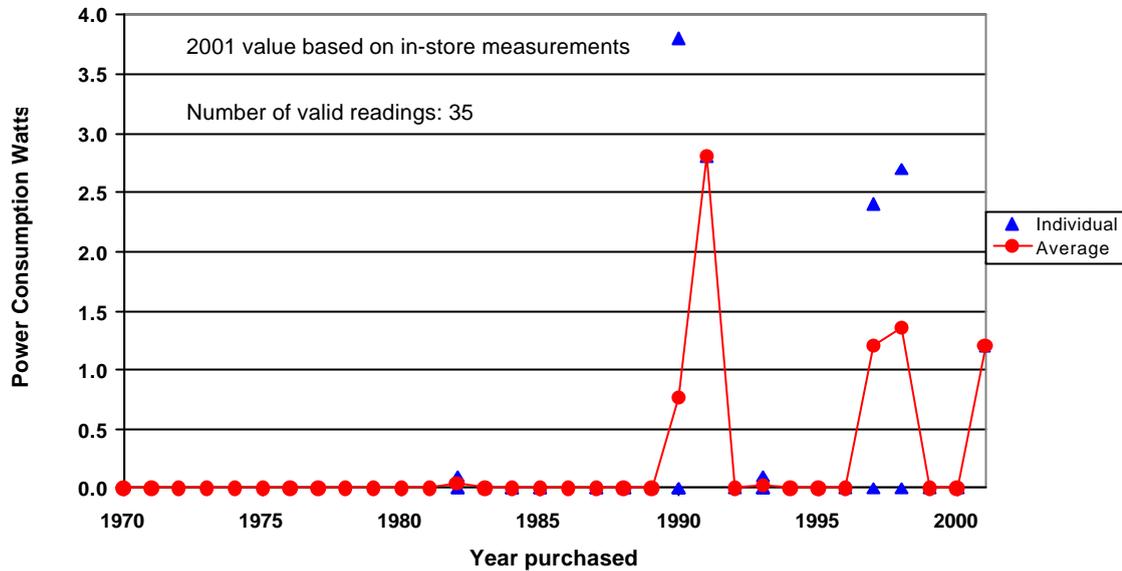


Figure 18 shows much fluctuation in the average power consumption for clothes dryers since 1989 due to a limited sample size. Results are indicative only.

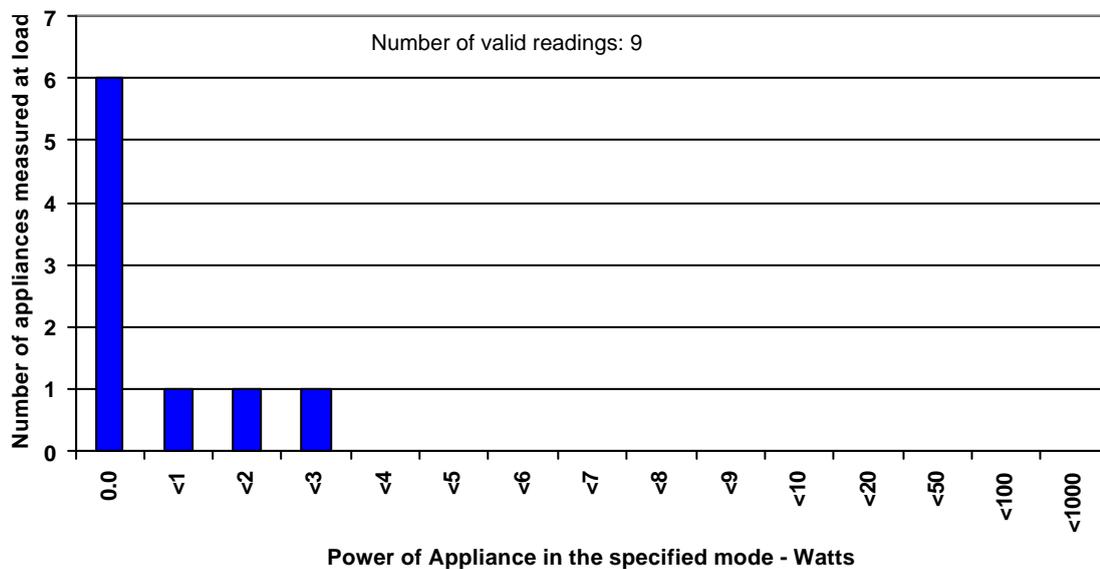
Figure 18 – Power consumption for clothes dryers: off mode



### Dishwashers

Dishwasher ownership was found to be 0.31 per house. Ownership is increasing slowly. Almost all were found in “off” mode when not in use. As with clothes dryers and clothes washers, electronics are increasing therefore standby is becoming more common. The stock average in off was 0.5W. In use readings during the intrusive survey were hard to obtain as most were “built in” or difficult to move. The results presented in Figure 19 are from a very limited number of readings (n=9), so this should be treated as indicative only.

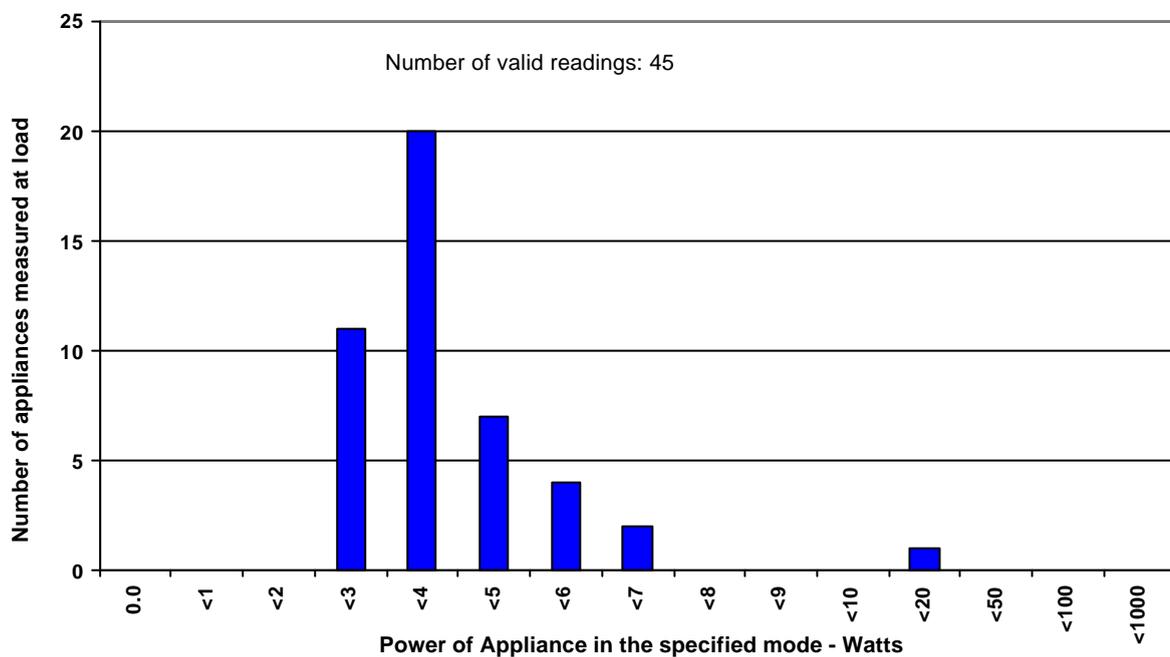
Figure 19 – Power measurements for dishwashers: off mode



## Microwave Ovens

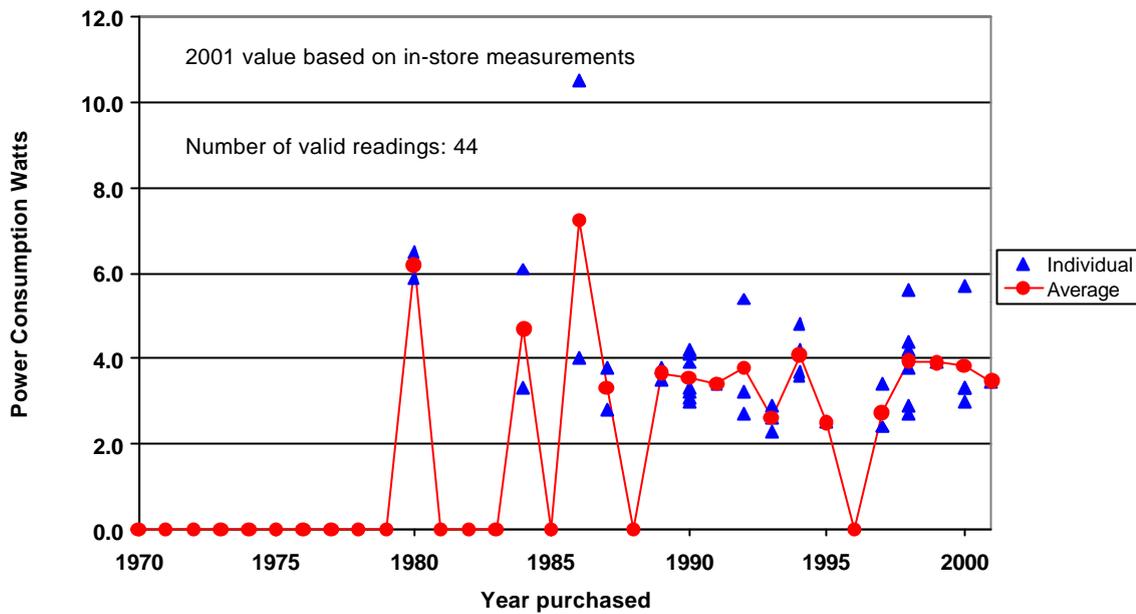
Microwave oven ownership was found to be 0.93 per house. Ownership is likely to be saturated although there is little independent data to confirm this trend. Most microwaves are found in “standby” mode when not in use (i.e. with the clock functioning). Some microwaves with a dial timer (less than 20% found in the intrusive survey) have only an off mode and generally these types of microwaves used 0.0 Watts in off mode (7 of the 10 had zero Watts in off mode, the other three had 0.2 Watts, 0.2 Watts and 2.4 Watts). A high proportion (20%) of households switch off the microwave at the wall – the reason for this is unclear. The average age of microwaves was found to be 7 years. Figure 20 shows that the majority of microwaves measured had a passive standby reading of greater than 4.0 watts (noting that the 10 manual timer models are excluded from this figure).

Figure 20 – Power measurements for microwave ovens: passive standby



The stock average standby was found to be 3.9 W, which appears to be stable. Figure 21 illustrates that there are no apparent trends in average passive standby for microwaves since the late eighties. New technological developments which allow the microwave clock to be turned off when not in use mean that the standby power consumption can be very low in new models, but few of these seem to be on the Australian market as yet. However, a handful of the 60 models measured in stores had a standby power consumption of about 1 Watt, which is significantly lower than any found in the intrusive survey. One European model had the option to turn off the clock display and this had a standby of 0.2W. So a downward trend in standby power during the period 2000 to 2005 may start to develop for microwave ovens.

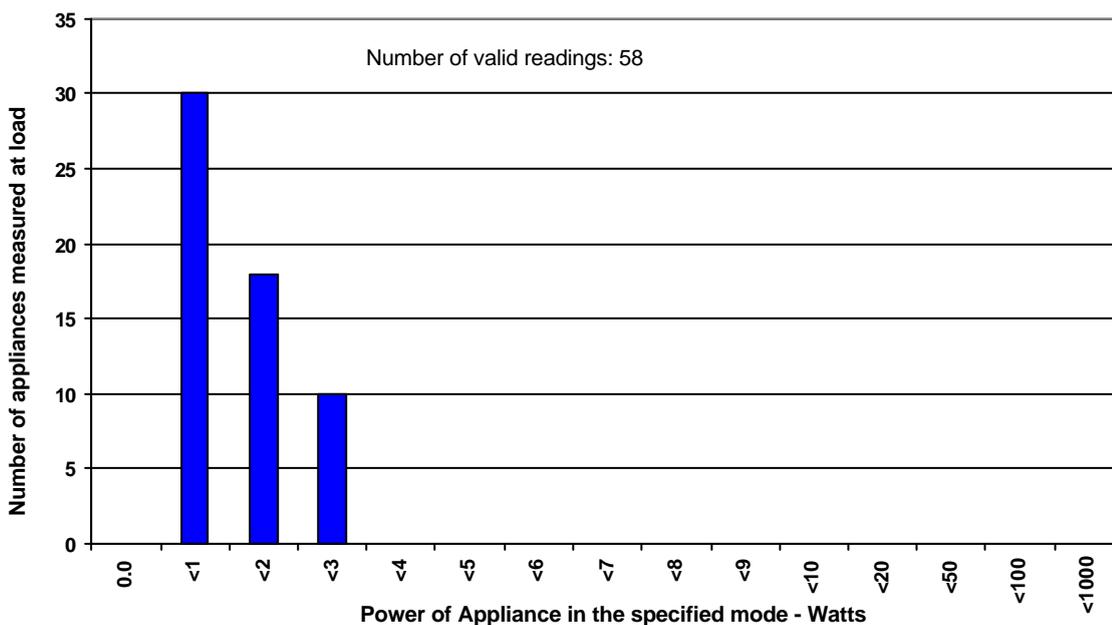
Figure 21 – Power consumption for microwaves: passive standby



**Mobile Phone Chargers**

Mobile phone ownership was found to be very high at 1.05 per house. 31% of chargers were found in “standby” mode (plugged in and on but not charging) when not in use, 69% were unplugged or disconnected. The stock average standby was found to be 1.2 W. The average age of mobile phones was found to be 2 years. Figure 22 illustrates the standby readings obtained for mobile phone chargers. Encouragingly, many of the newer models had a standby of around 0.5 Watt.

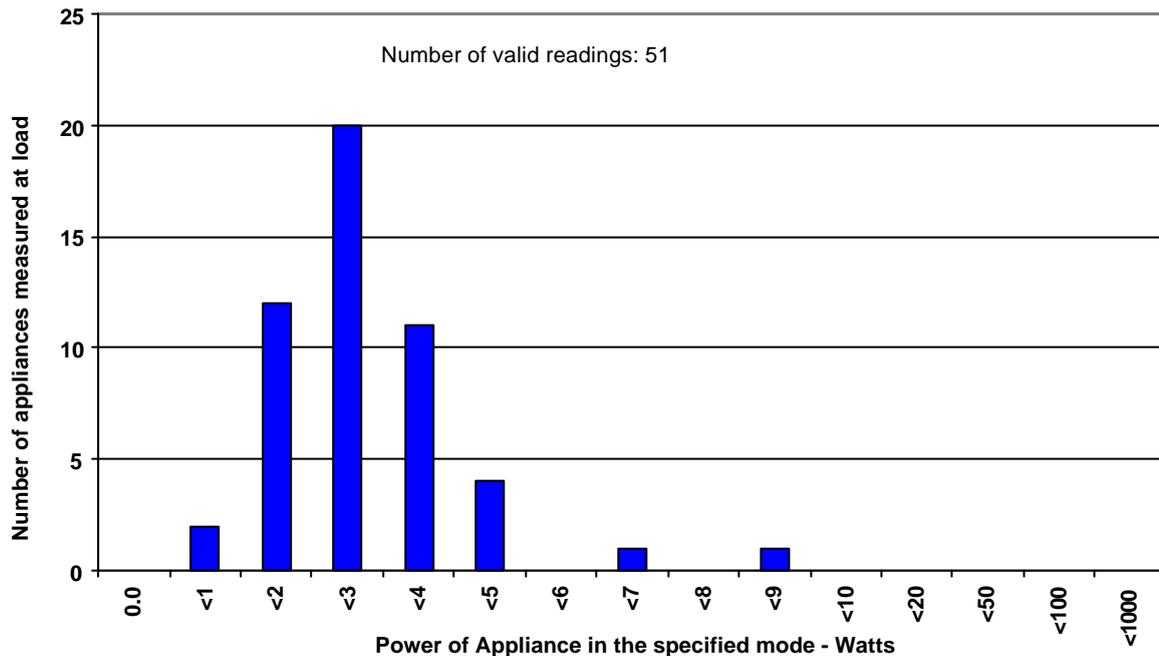
Figure 22 – Power measurements for mobile phone chargers: passive standby



### Cordless Phones

Cordless phone ownership was 0.51 per house. Ownership is quite high, but trends are unknown (probably increasing). Most cordless phones are in “standby” mode (plugged in and on, fully charged) when not in use. The stock average standby was 2.7 W and stable (not decreasing). Figure 23 shows that passive standby for cordless phones is generally between 2 and 5 watts. In most cases this is primarily the standing no load loss of the transformer power supply, although some battery charging systems tend to dump significant power when fully charged.

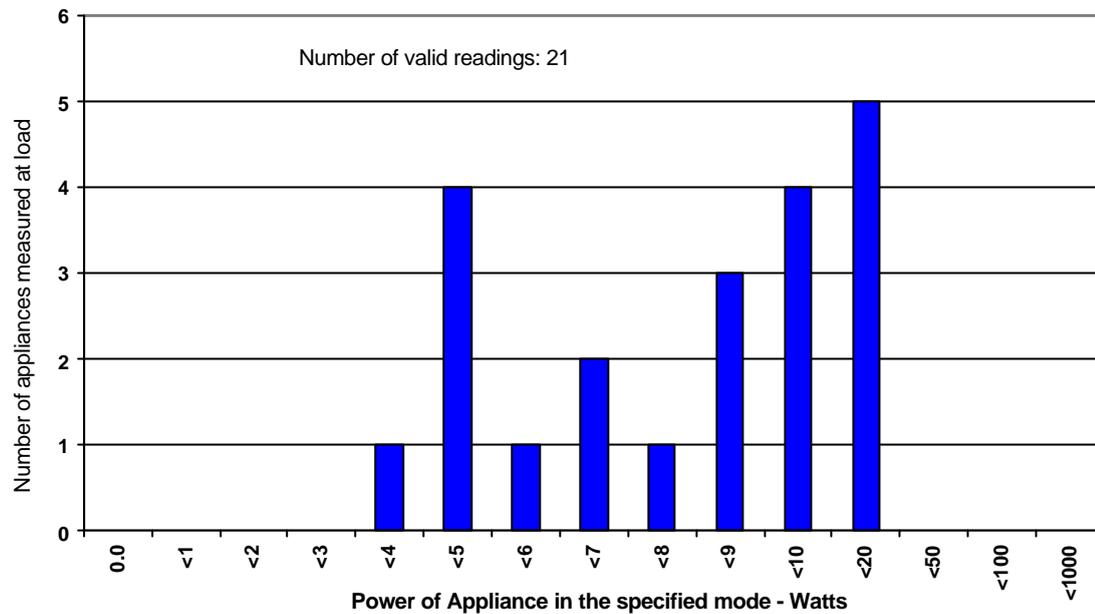
Figure 23 – Power measurements for cordless phones: passive standby



### Fax Machines

Fax machine ownership was found to be 0.17 per house. Ownership is moderate and trends are unknown (possibly increasing, although email communication associated with the increasing number of households with internet access may slow fax ownership). Most were found to be in “standby” mode (plugged in and on), with 27% only on as required. The stock average standby was 8.2 W (poor), but appears to be marginally decreasing. The average age was 5 years. Figure 24 illustrates that a high proportion of fax machines measured recorded passive standby readings of greater than 9.0 watts. Note that again, the sample size is small (n=21) so results should be interpreted as indicative only.

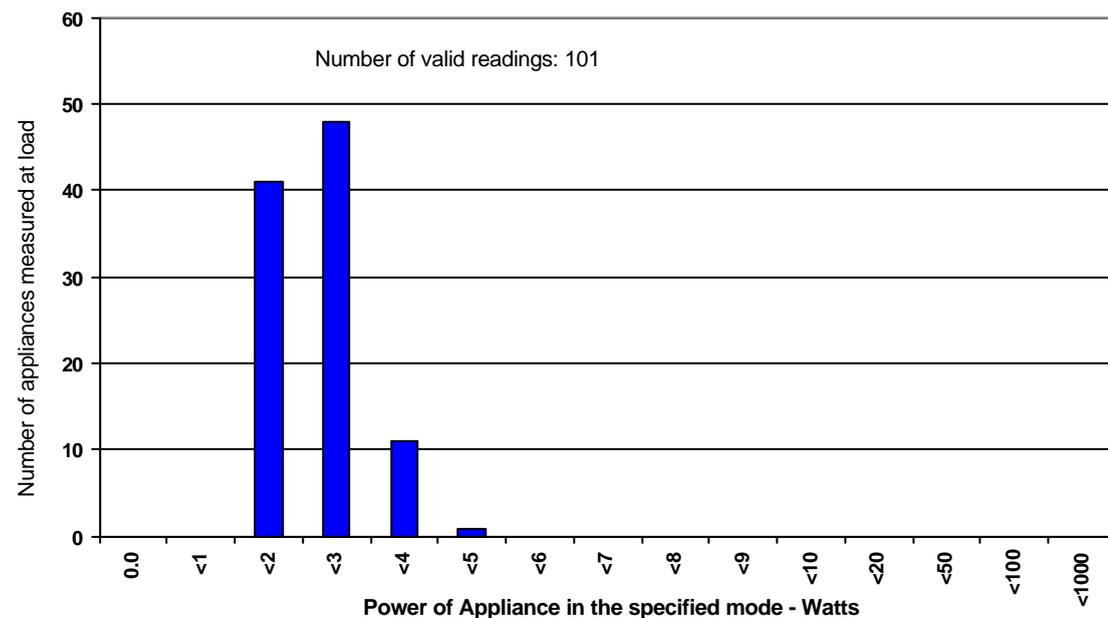
Figure 24 – Power measurements for fax machines: passive standby



### Clock Radios

Clock radio ownership was found to be 1.4 per house. Ownership is very high, and the market is likely to be saturated. All clock radios were found to be in “on” mode meaning that the time function was showing but the radio was off. The stock average in use power was 2.1 W. Figure 25 illustrates that the majority of clock radios recorded readings of between 1.0 watts and 5.0 Watts in on mode.

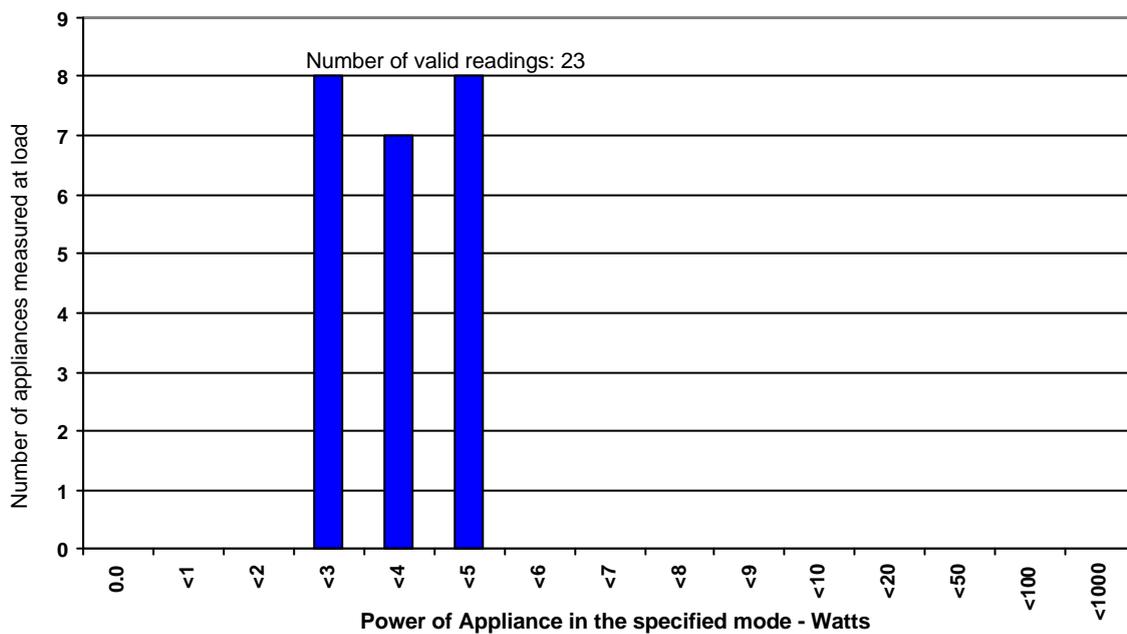
Figure 25 – Power measurements for clock radios: in use



### Answering Machines

Answering machine ownership was found to be 0.42 per house. Ownership is moderate and the market is probably saturated, although there is no data to suggest a trend in ownership. Most answering machines were found in “standby” mode (ready to answer calls). The stock average standby was 3.3 W. In most cases this is primarily the standing no load loss of the transformer power supply. Figure 26 shows the standby readings obtained from the survey.

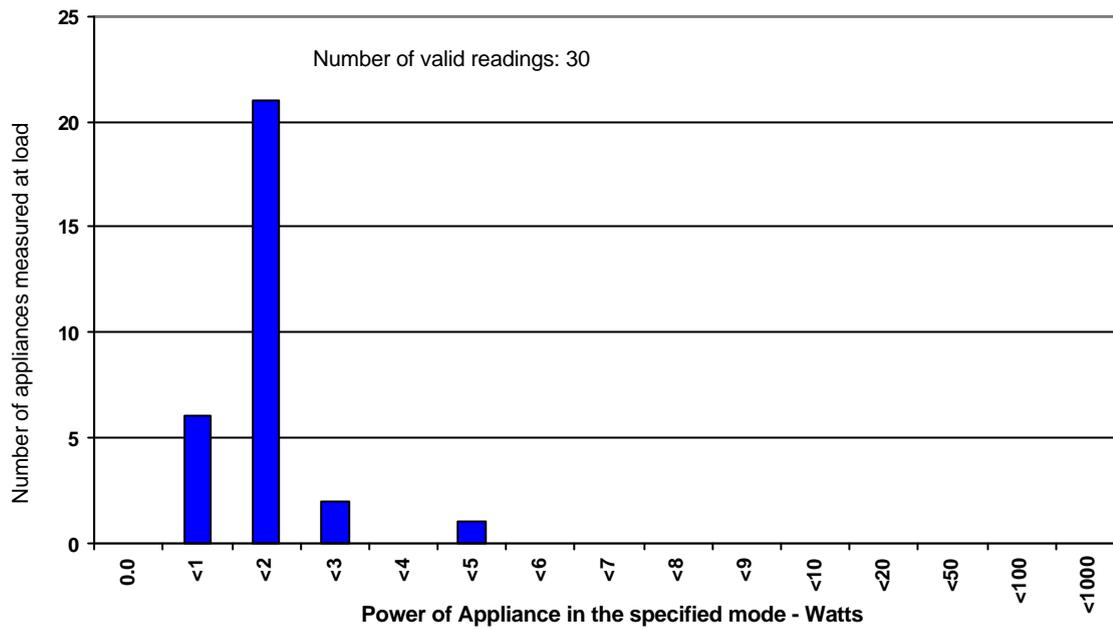
Figure 26 – Power measurements for answering machines: passive standby



### Dustbusters

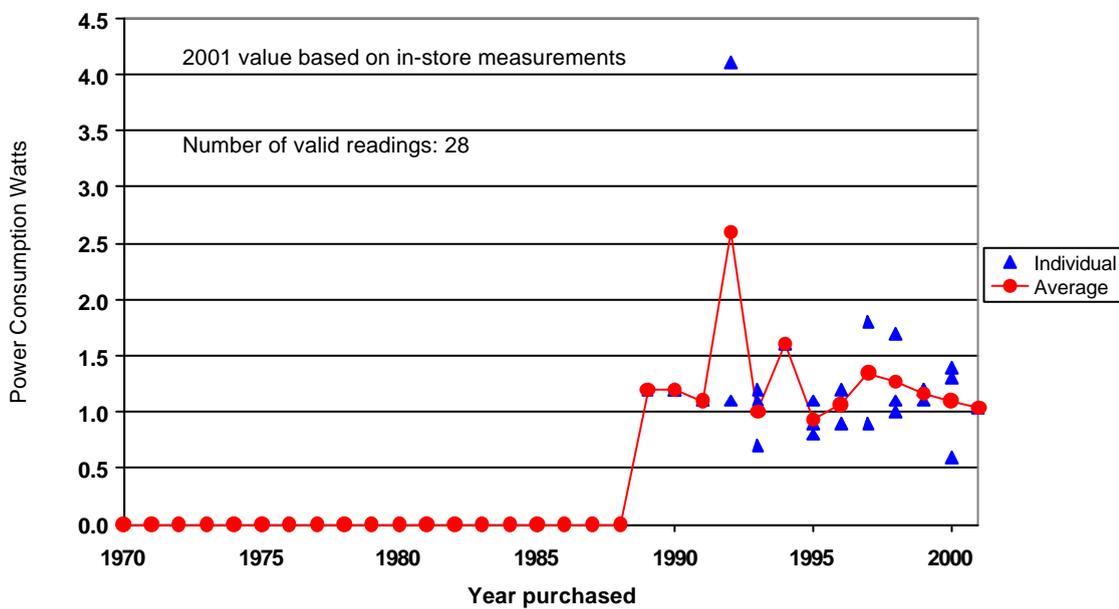
Dustbuster ownership was found to be 0.26 per house (dustbusters are portable vacuum cleaners). Ownership is moderate and possibly increasing. Most were found in “standby” mode (battery fully charged with the charger on). Figure 27 illustrates that most readings were less than 2.0 watts.

Figure 27 – Power measurements for dustbusters: passive standby



The stock average standby for dustbusters was 1.3 W and stable (not decreasing markedly). Figure 28 illustrates the trends over time.

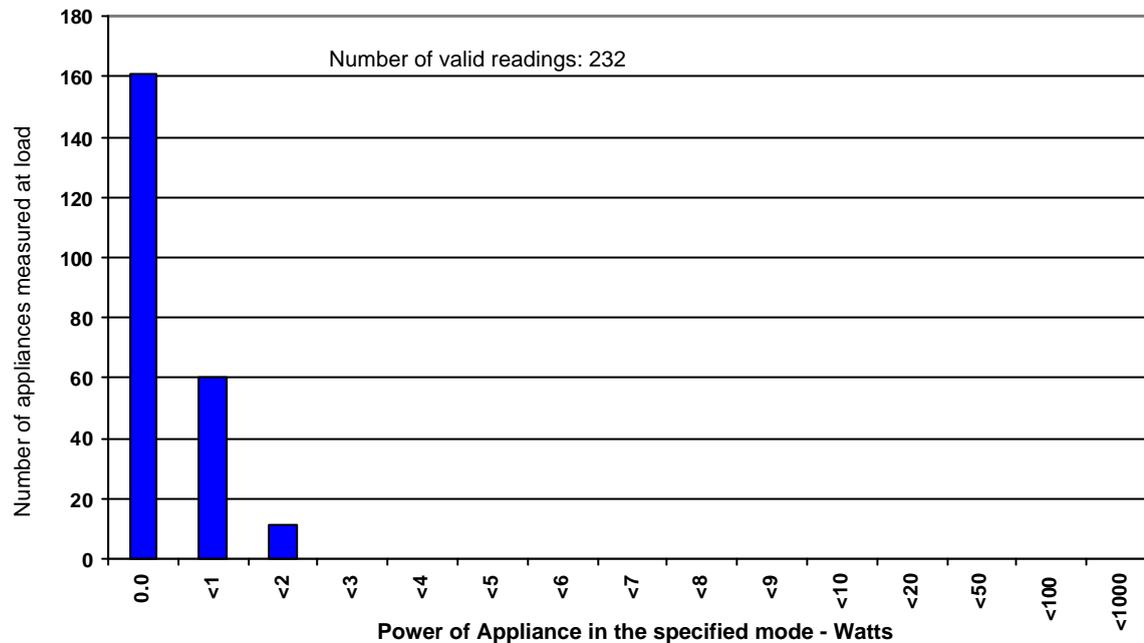
Figure 28 – Power consumption for dustbusters: passive standby



### Power Distribution Boards

Power Distribution Board ownership is high, at about four per house. Most have no power consumption in use, although models with inbuilt surge protection or power indicator lights consume small amounts of power. The stock average standby was 0.1 W. Figure 29 illustrates that approximately one third (31%) of power boards consumed more than zero watts.

Figure 29 – Power measurements for power boards: in use



### Small Appliances

Appliances grouped under this category include: breadmakers, coffee machines, fans, microwaves and rangehoods. Many small appliances were not measured such as irons, vacuum cleaners, hair dryers, toasters etc. as most of these are zero Watts in off mode and many are not left connected with the power on. Fans and rangehoods were found to have mostly 0.0 W in off mode. Breadmaker ownership is increasing and they average 2.0W in standby (for this study this mode was classified as standby but it could be argued that the mode while not in use or in time delay mode is really off mode rather than standby).

### Other Audio Visual Appliances

Appliances grouped under this category include: stereo systems (those with separate components and integrated systems), pay TV decoders and DVDs. TVs and VCRs are not included in this category. The intrusive survey revealed that there are a large number of other audio visual appliances per household with the average being five per house. Appliances in this category generally had a very poor energy consumption profile in both off mode and standby mode and many have no off mode. Figure 30 illustrates that a high proportion (57%) of other audio visual equipment measured had an off consumption of greater than zero watts. A very small number of appliances recorded readings in off mode of greater than 20 Watts.

Figure 30 – Power measurements for other audio visual equipment: off mode

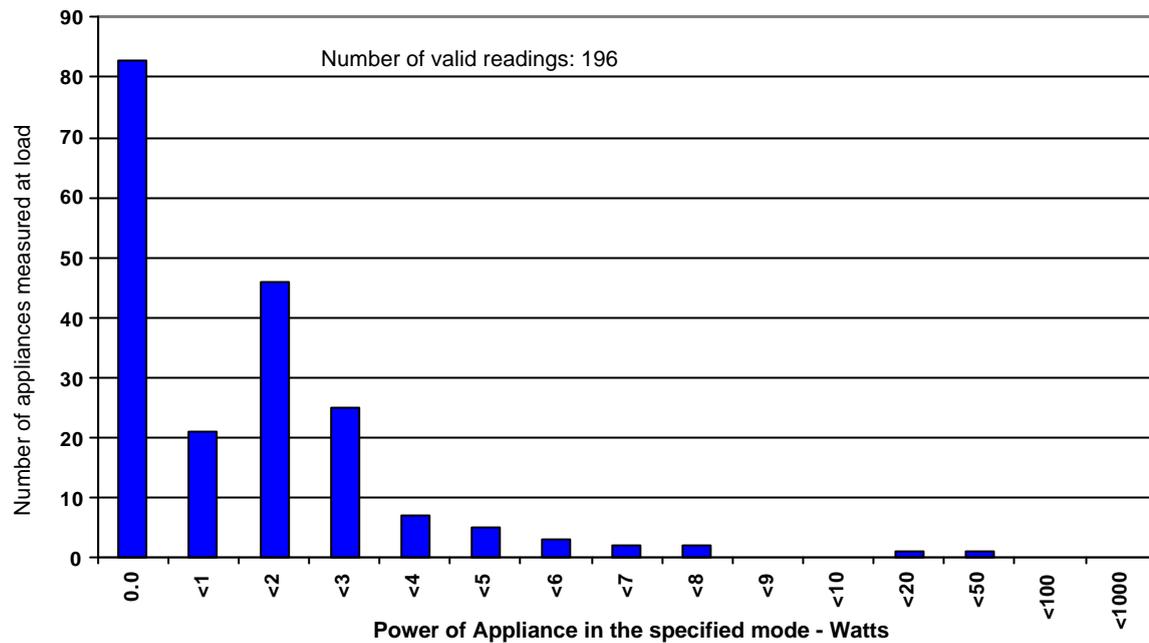


Figure 31 shows measurements of audio visual equipment in passive standby. The poor performance of appliances in this category is evident with nearly one third (32%) of appliances measured recording a standby power of greater than 10 Watts. It is believed that an increase in visual displays in stereo equipment has contributed to the poor standby performance of appliances in this category.

Figure 31 – Power measurements for other audio visual equipment: passive standby

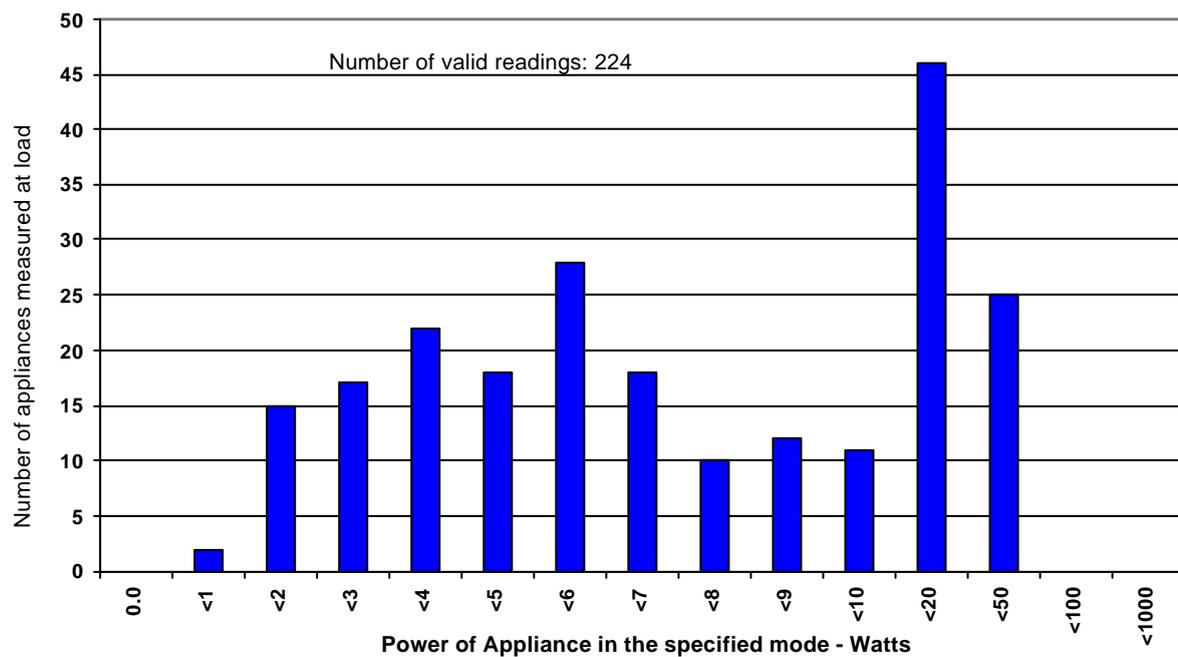


Figure 32 illustrates the change in average off mode since 1970. There seems to be no improvement in consumption for appliances in off mode in recent years. The average off mode (where present in appliances) was 1.3 Watts.

Figure 32 – Power consumption of other audio visual equipment: off mode

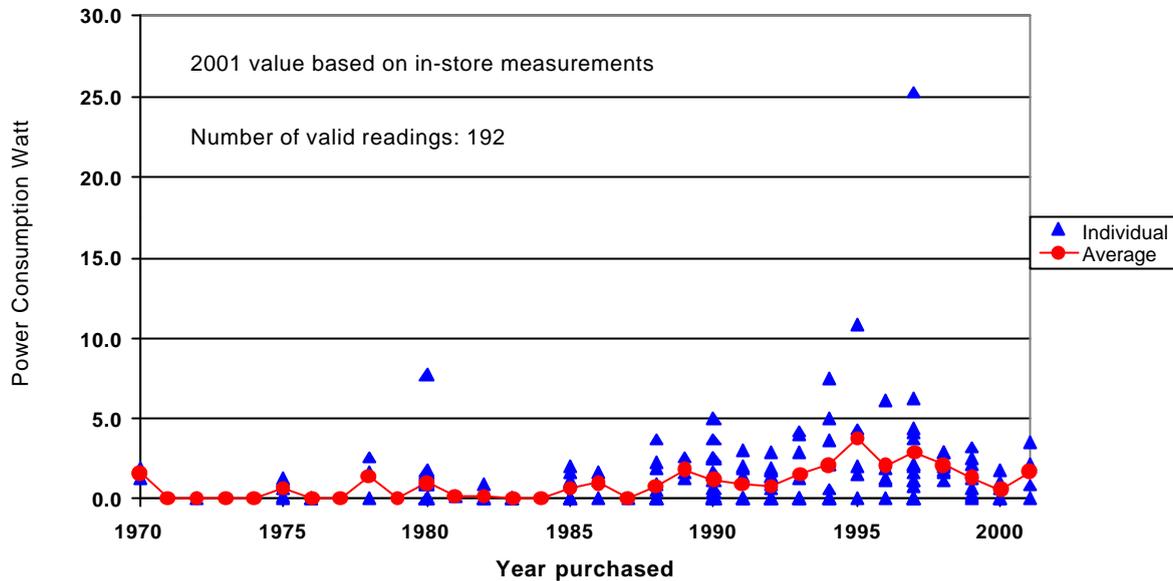
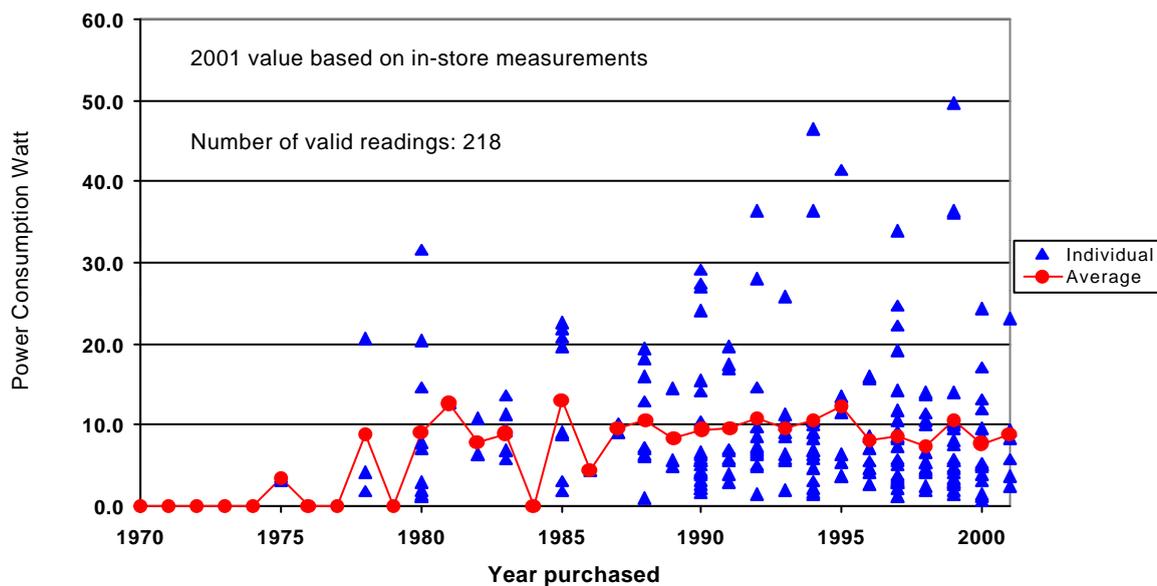


Figure 33 illustrates the great variation in passive standby of other audio visual equipment. No improvement in passive standby appears to have been made in past ten years. The average standby was 9.5 Watts.

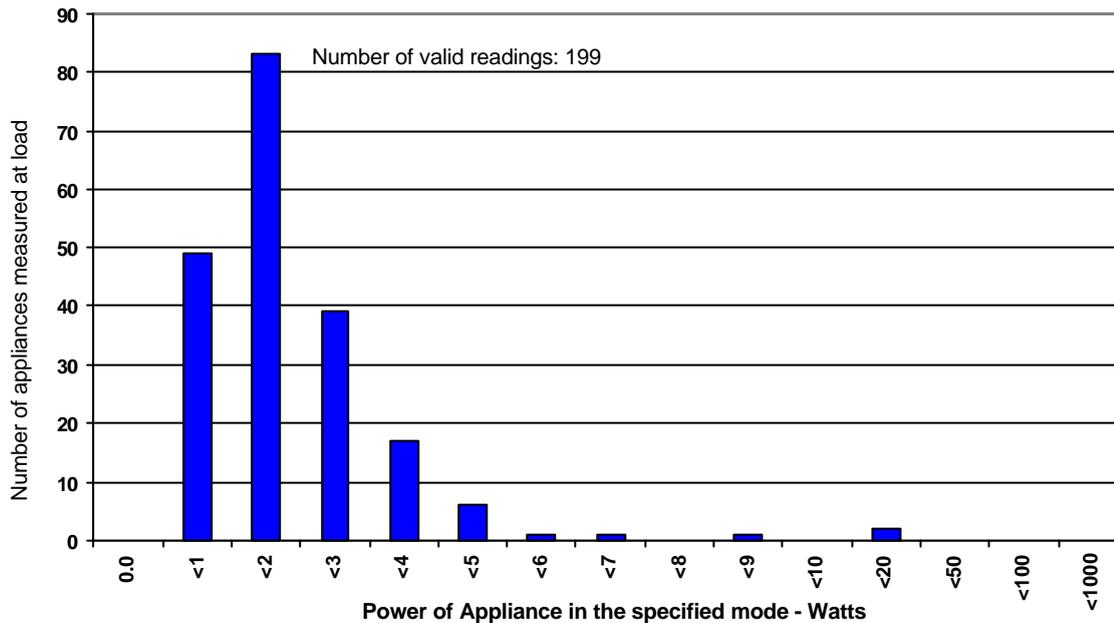
Figure 33 – Power consumption of other audio visual equipment: passive standby



### Battery Operated Appliances

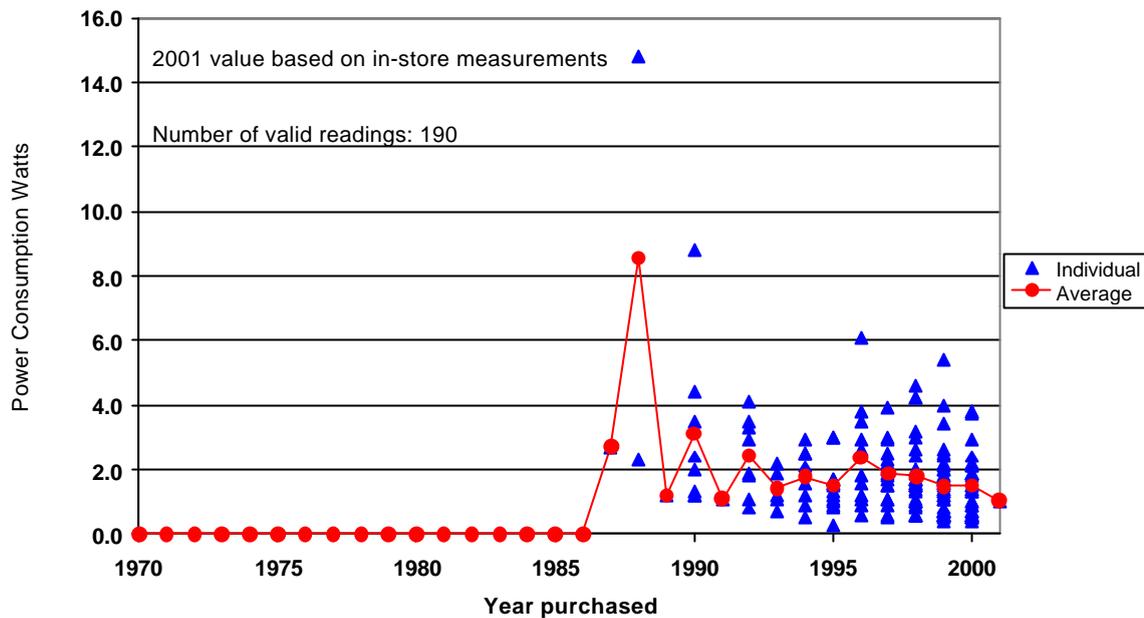
This category includes battery chargers of all types such as for electric toothbrushes and shavers, video cameras (note that the data includes dustbusters, mobile phone chargers & cordless phones which have also been examined separately). Also included in this group are halogen lamps with a low voltage switch. Ownership of “battery operated appliances” was high at 3.5 per house. Figure 34 illustrates that passive standby ranges from as little as less than one watt to almost 20 watts.

Figure 34 – Power measurements for transformers and battery operated appliances: passive standby



The average standby was found to be 1.9 Watts. There has been no marked improvement in standby in recent years as illustrated in Figure 35 below, although there is a slight improvement in the trend since 1996.

Figure 35 – Power consumption for transformers and battery operated appliances: passive standby



### Continuous and Monitoring Appliances

This category includes alarms, answering machines, clocks & clock radios, faxes, fish tank accessories, remote garage door openers, powerboards, mains powered smoke detectors (although none were measured), surge protectors and timers (many of these items have been examined separately above). There are a large number of such appliances per house with the survey finding 7.6 per house. Half of these were power boards.

The average in use value for continuous and monitoring appliances was 3.5 Watts. However, it should be noted that if powerboard & garage openers were excluded, the average standby was 4.8 Watts per item. Remote control garage door openers alone also averaged 4.8 Watts in passive standby mode. Mains powered smoke detectors are now mandatory in all new houses built and as such, ownership of smoke detectors is increasing rapidly. It was not possible to obtain any power data for smoke detectors from the survey.

### Cooking Appliances

Cooking appliances include cook tops, ovens and combinations of all fuels. Virtually no readings were obtained, as most electric cooking appliances are “hard” wired. Most cooking appliances will have a standby (clock function) which is estimated initially at 3 Watts. A limited number of gas ignition systems measured appeared to have no standby.

### Water Heaters

This category includes water heaters of all fuels with an electric connection. No readings were possible as most are “hard” wired or the plug was not accessible. Electric water heaters are excluded, but gas water heaters with electronic ignition will have some standby, however, the amount of standby is not known.

### Miscellaneous Appliances

Miscellaneous appliances include those which were not included under other categories: amplifiers for aeriols, air fresheners, power tools (mains powered only), heated towel rails, touch lamps & nightlights (for children), musical instruments (keyboards), fitness equipment, water pumps/fountains/filters/coolers. Miscellaneous appliances had an average off mode power consumption of 1.5 Watts. Standby was found to be 8.0 Watts for this category. Some equipment measured recorded very high consumption in off mode, including one treadmill which measured 32 Watts. Standby from miscellaneous appliances may be an emerging problem area, although not enough data was collected on product types to identify potential areas of concern. The ownership of miscellaneous products was relatively low (just over 1 per house). Figure 36 shows the variation in energy consumption for appliances in off mode, while Figure 37 illustrates variation in passive standby.

Figure 36 – Power measurements for miscellaneous appliances: off mode

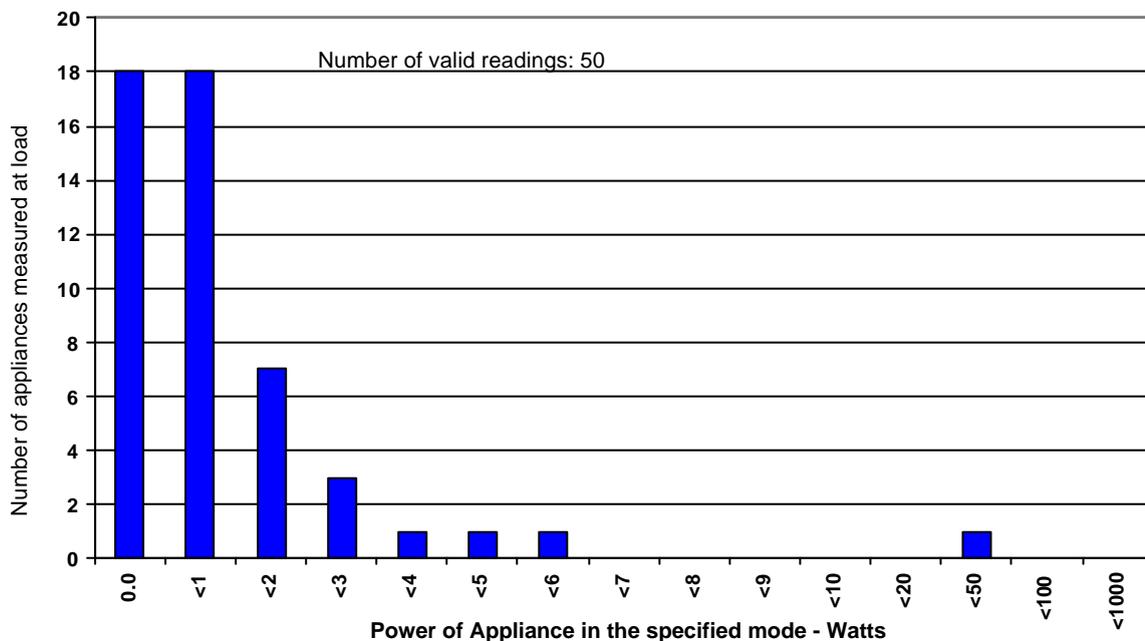
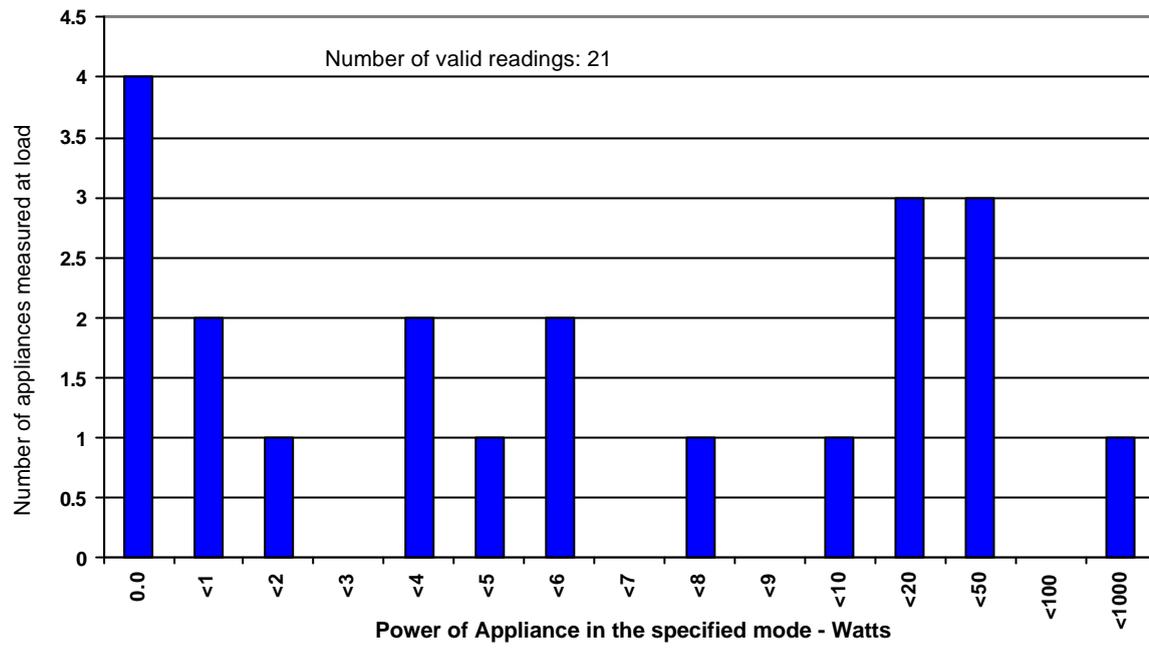


Figure 37 – Power measurements for miscellaneous appliances: passive standby



## Appliance ownership survey

### ***Aims & objectives***

The appliance ownership survey was necessary to augment data on appliance usage obtained in the intrusive survey. The main aims of the appliance use survey were to determine:

- The number and types of appliances present in households throughout Australia;
- The age of those appliances; and
- Householder behaviour in relation to appliance usage (e.g. how appliance is switched off, how often appliance is in use).

Other information such as appliance brand name was collected to provide further insight into the market presence of certain appliances that may have shown high standby readings from the intrusive survey.

The larger sample size of the appliance use survey compared to the intrusive survey allowed more reliable results to be obtained on appliance ownership, penetration, and saturation. One of the limitations of a phone survey is survey length, as the respondent drop out rate and level of participation falls dramatically for a survey of over fifteen to twenty minutes in length. Therefore, it was not possible to obtain usage data, or age of appliance for all types of appliances. As such, some appliance types were not covered by the survey. The appliance use survey followed the intrusive survey. This allowed identification of those appliances most commonly present in households and provided a guide on which appliances to include in the appliance use telephone survey.

### ***Approach***

The appliance use survey was conducted nationwide by telephone. 801 households were surveyed, achieving a sample accuracy of  $\pm 3\%$  at a 95% confidence level. The sample was drawn proportionally from each state including a proportional representation of metropolitan and rural households. Households were chosen randomly chosen using White Pages listings.

### ***Results***

Table 2 below shows saturation<sup>7</sup>, penetration, ownership and average appliance age per appliance. Televisions (not surprisingly) showed the highest ownership with 1.9 televisions per house while clock radios, VCRs, stereos and mobile phones also revealed high ownership and penetration. As mentioned earlier, certain data was not collected for some appliances which is why age data is missing for some appliances listed in Table 2.

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<sup>7</sup> Note that saturation is the average number of appliances per house for those houses that own one or more of the appliance.  $\text{Saturation} \times \text{Penetration} = \text{Stock}$ .

Table 2 – Appliance saturation, penetration, ownership and mean age

<b>Appliance</b>	<b>N</b>	<b>Saturation</b>	<b>Penetration</b>	<b>Ownership</b>	<b>Mean Age</b>
Televisions	797	1.9072	99.6%	1.900	8
Clock Radios	644	1.7391	80.4%	1.398	
VCRs	712	1.3553	89.0%	1.206	6
Stereos	675	1.4119	84.3%	1.190	8
Mobile Phones	527	1.5977	65.8%	1.051	2
Electric Kettles	713	1.0659	89.0%	0.949	4
Microwaves	713	1.0393	89.0%	0.925	7
Personal Computers	460	1.2783	57.4%	0.734	4
Smoke Detectors	267	1.9888	33.4%	0.664	
PC Monitors	426	1.2418	53.2%	0.661	
Printers	412	1.1505	51.5%	0.593	4
Speakers	363	1.2837	45.4%	0.583	
Cordless Home Phones	376	1.0824	46.9%	0.508	
Answering Machines	321	1.0405	40.1%	0.417	
Electric Shavers	274	1.1387	34.2%	0.389	6
Play Station/Game Consoles	215	1.1907	26.8%	0.319	
Plug in Air Fresheners	129	1.7442	16.1%	0.281	
Dustbusters	199	1.0302	24.9%	0.257	
Coffee Machines	186	1.0753	23.2%	0.249	7
Bread Makers	174	1.0115	21.7%	0.219	3
Electric Toothbrushes	133	1.2331	16.6%	0.205	2
Fish Tanks	119	1.2185	14.9%	0.182	
Fax Machines	136	1.0147	17.0%	0.172	5
Scanners	126	1.0397	15.7%	0.163	2
Laptops	98	1.1531	12.2%	0.141	
DVDs	66	1.0909	8.2%	0.089	2
Digital TVs **	53	1.1132	6.6%	0.073	
Multi-Function Devices	47	1.0426	5.9%	0.062	4
Photocopiers	35	1.0571	4.4%	0.047	4

Note \*\*: The reported incidence of digital TV ownership was surprisingly high as the service in Australia was only commenced within a few weeks of the survey. Respondents may have incorrectly said that they have digital TV when in fact they had cable or satellite based pay TV.

### Ownership, Penetration & Saturation

A comparison of ownership, penetration and saturation between the appliance use telephone survey and the intrusive survey shows that the intrusive survey matched data obtained from the appliance use survey. The main discrepancies in ownership were found on VCRs and clock

radios where the ownership was greater in the intrusive survey. Personal computers, computer monitors and other computer peripherals (including fax machines) also showed a higher ownership in the intrusive survey. However, considering that a high proportion of respondents in the intrusive survey were from high income households (Choice subscribers), this result is not surprising. The comparison between the two surveys (sorted by ownership in the appliance use survey) is shown below in Table 3. Note that data for electric kettles, smoke detectors and digital TVs was not collected in the intrusive survey and as such “n/a” is shown for these appliance types.

Table 3 – Appliance saturation, penetration and ownership: comparison between the intrusive and appliance use surveys

Appliance Type	Appliance Use Survey			Intrusive Survey		
	Saturation	Penetration	Ownership	Saturation	Penetration	Ownership
Televisions	1.9072	99.6%	1.900	1.8730	98.4%	1.844
Clock Radios	1.7391	80.4%	1.398	1.8704	90.6%	1.695
VCRs	1.3553	89.0%	1.206	1.5000	96.9%	1.453
Stereos	1.4119	84.3%	1.190	1.5000	59.4%	0.891
Mobile Phones	1.5977	65.8%	1.051	1.4419	67.2%	0.969
Electric Kettles	1.0659	89.0%	0.949	n/a	n/a	n/a
Microwaves	1.0393	89.0%	0.925	1.0000	84.4%	0.844
Personal Computers	1.2783	57.4%	0.734	1.4561	89.1%	1.297
Smoke Detectors	1.9888	33.4%	0.664	n/a	n/a	n/a
PC Monitors	1.2418	53.2%	0.661	1.4151	81.3%	1.150
Printers	1.1505	51.5%	0.593	1.4909	89.1%	1.328
Speakers	1.2837	45.4%	0.583	1.2045	68.8%	0.828
Cordless Home Phones	1.0824	46.9%	0.508	1.2727	68.8%	0.875
Answering Machines	1.0405	40.1%	0.417	1.0417	37.5%	0.391
Electric Shavers	1.1387	34.2%	0.389	1.0000	12.5%	0.125
Play Station/Game Consoles	1.1907	26.8%	0.319	1.1111	14.1%	0.156
Plug in Air Fresheners	1.7442	16.1%	0.281	1.2500	12.5%	0.156
Dustbusters	1.0302	24.9%	0.257	1.1667	39.1%	0.456
Coffee Machines	1.0753	23.2%	0.249	1.0000	6.3%	0.063
Bread Makers	1.0115	21.7%	0.219	1.0000	17.2%	0.172
Electric Toothbrushes	1.2331	16.6%	0.205	1.0000	20.3%	0.203
Fish Tanks	1.2185	14.9%	0.182	1.2000	15.6%	0.188
Fax Machines	1.0147	17.0%	0.172	1.0000	32.8%	0.328
Scanners	1.0397	15.7%	0.163	1.0000	35.9%	0.359
Laptops	1.1531	12.2%	0.141	1.0909	17.2%	0.188
DVDs	1.0909	8.2%	0.089	1.1429	10.9%	0.125
Digital TVs	1.1132	6.6%	0.073	n/a	n/a	n/a
Multi-Function Devices	1.0426	5.9%	0.062	1.0000	4.7%	0.047
Photocopiers	1.0571	4.4%	0.047	1.0000	1.6%	0.016

## Hours of Use

Table 4 shows the average hours of use per appliance. Note that DVDs showed a high average usage, however, the sample size is small (n=19) so the result should be treated as qualitatively. To assist with survey brevity, hours of use data was only collected on the appliance types listed in Table 3.

*Table 4 – Usage data per appliance*

<b>Appliance Usage</b>	<b>N</b>	<b>Mean</b>
TVs - hours watched yesterday	792	2.96
VCRs - hours switched on yesterday	661	3.74
DVD - hours switched on yesterday	19	9.95
Stereo - hours switched on yesterday	464	1.39
PC - hours on yesterday	264	5.18
Printer - hours on yesterday	408	1.56
Breadmakers - Loaves made yesterday	29	1.14
Breadmakers - Loaves per week	116	2.97
Coffee Machines - Cups of Coffee made yesterday	53	4.30
Electric Kettles - Cups Boiled yesterday	691	6.51

## Store Data

### *Aims & objectives*

The principle aim of the store data measurements was to collect data on standby consumption of current stock. This data collection exercise strengthened the data already obtained in the intrusive survey on the installed stock and provided a benchmark for the year 2001 for future data comparison.

### *Approach*

Using the same meter used for the intrusive survey, measurements were undertaken in one major appliance retail store in Brisbane and one in Sydney. Measurements were taken of floor stock present in both stores and included appliances such as: TVs, VCRs, microwaves, clothes washers, clothes driers, DVDs, stereo equipment, bread makers and dustbusters. Some less common appliances were also measured including minidisk players and CD writers.

In total, 533 appliances were measured. As with the intrusive survey, appliances were measured where applicable in use, in standby (passive or active) and off.

### *Results*

Table 5 shows the mean in use, passive standby and off recordings for appliances measured in stores. Where sample sizes dropped below seven, means were not calculated. A sample size of less than 20 is too small to provide reliable results for means. However, as mentioned earlier, the store data results helped to strengthen the data point for 2001 data in the intrusive survey and to provide a benchmark for future monitoring of standby among appliances used in the Australian residential sector.

*Table 5 – Mean in use, passive standby and off measurements recorded in stores*

<b>Appliance Type</b>	<b>N</b>	<b>In use</b>	<b>Passive Standby</b>	<b>Off</b>
Amp/Tuner	7	37.05	23.35	2.83
Breadmaker	12		1.63	
CD Player	14	9.13	7.98	2.16
Dryer	7			1.20
Dustbuster	9	3.56	1.03	
DVD	31	17.42	5.81	0.83
Microwave	60		3.47	
Stereo - Portable	36		2.81	5.27
Stereo Unit - Integrated	88	23.94	9.31	3.52
Tuner	4	47.25	3.65	0.00
TV	157	93.65	5.94	0.03
VCR	39	14.25	3.81	1.27
Washing Machine	35			3.79

## Analysis of Historical Monitoring Data

### **Background**

In 1993-1994 NSW electricity utilities (lead by the Electricity Commission of NSW (Pacific Power) and Sydney Electricity – both utilities have since changed their structure and names) undertook an end use monitoring program, primarily in order to understand appliance use and its impact on energy consumption of peak electricity demand.

Half hourly data was recorded for the whole house and 8 separate appliances in about 300 houses for around 1 year in the state of New South Wales.

In late 2000, the Building Research Association of New Zealand (BRANZ) were commissioned by the AGO to provide an analysis of miscellaneous and standby power usage for each individual household in the sample, specifically excluding energy demand due to refrigerators, freezers and water heaters; and provide an estimate of the miscellaneous and standby power usage for NSW for 1993/94.

The BRANZ study analysed half-hourly electricity use data for each household in the sample to determine the baseload and standby power, and these values converted to a representation of baseload and standby power for NSW.

### **Aims & objectives**

The analysis of the BRANZ data allowed estimates in the growth of standby power consumption to be made.

### **Approach**

The analysis by BRANZ was used to determine a “baseload” value for each household within the survey. This is an estimate of the lowest commonly occurring power consumption for a house. This should include both standby power of individual appliances, and any continuous loads in the house.

For each day, the minimum half hourly value energy value is calculated from the monitoring data. Provided that at some time of day all appliances in the house are in standby mode, and no user demand is present, this value will be equal to the so called “baseload” of the house. How many times this occurs per day will vary from house to house, depending on the appliance and occupant activity within the house. The data was carefully analysed and all refrigeration loads (refrigerators and freezers) and water heater loads were excluded from the data. By examining the histogram of daily minima, the “baseload” may be estimated. A full description of the analysis and the results are shown in BRANZ (2001).

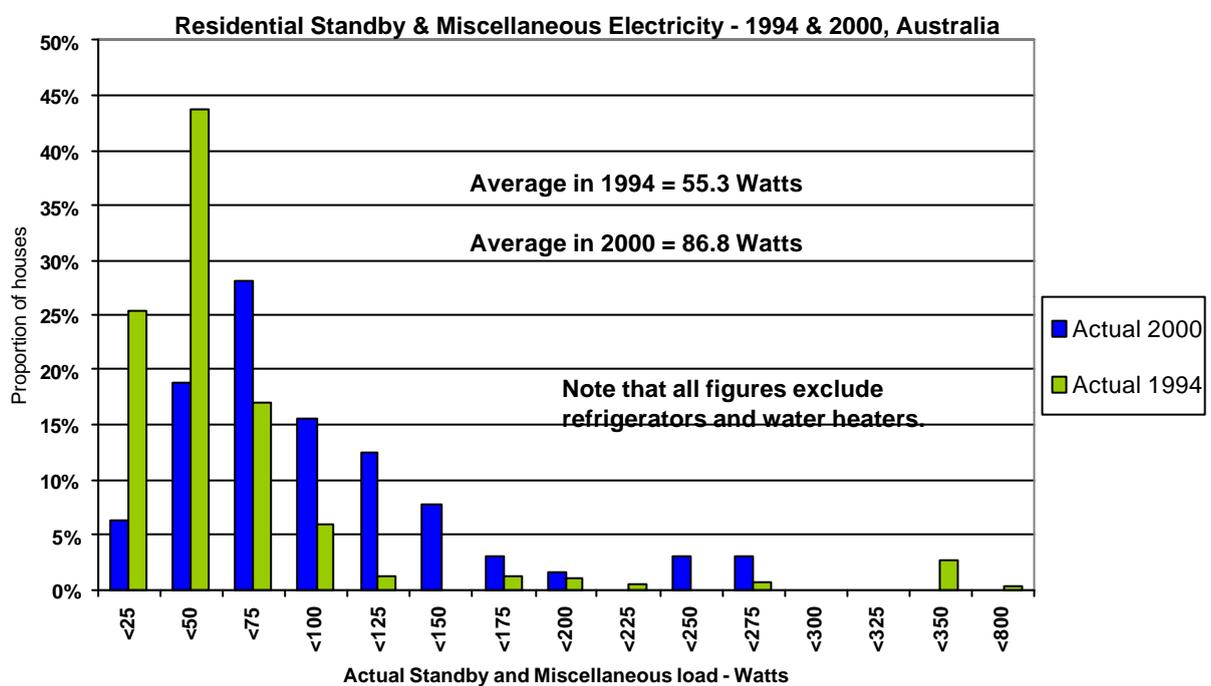
Due to problems with internal consistency of the data in some of the households, it was only possible to estimate the “baseload” value using 120 of the 300 houses. However, the result is considered to be representative of households in 1993-1994. Note that the sample used is stratified into 5 energy consumption bands so the results for individual houses need to be weighted in accordance with the relevant stratum to get a state wide average.

## Results

Based on the analysis of the data from 1993/94 NSW Residential Energy Study, the average baseload per house in NSW during 1993/94 was 55.3 Watts with an approximate standard error of 6.4 Watts. In NSW in 1993/94 the report estimated that the “baseload” was of the order of 133 MW, which was equivalent to 1,066 MWh of electricity over the year. The distribution of the household “baseload” values is shown in Figure 38. Note these are weighted in accordance with the relevant stratum for each house.

The shape of the distribution in 1994 is similar to 2000, but the values have increased somewhat. Even though the methodologies used in 1994 and 2000 are somewhat different, the approach used in 2000 is thought to be somewhat conservative.

Figure 38: Standby & Miscellaneous Electricity, Australia – 1994 & 2000



These results imply an 8% per annum growth in miscellaneous and standby electricity consumption from 1994 to 2000 (i.e. doubling every 9 years).

## Conclusions

- Results indicate that standby and miscellaneous power consumption in the residential sector could be increasing at approximately 8% per annum, which implies that greater efforts need to be made to ensure appliance efficiency is improved.
- Programs to influence householder behaviour in relation to the use of appliances is not going to have a significant effect on standby power consumption, except for selected appliances such as TVs where there is still a substantial difference between standby and off modes. While consumers can be encouraged to continue to unplug and switch off appliances at the mains when not in use, this is not a very realistic basis for a communication campaign (inconvenient and any savings are not likely to persist).
- The largest long term savings will be achieved by reducing the standby and off mode power consumption of new appliances offered on the market.
- A large proportion of appliances were found to have significant power consumption in both standby and off modes. Greater use of hard “off” switches or better design of soft touch switches would help to reduce off mode consumption. VCRs, computer peripherals, some small appliances such as breadmakers and electric kettles, audio and visual equipment (particularly integrated stereo units) are the main offenders.
- Off mode power consumption is poor for some appliance types (white goods, audio and visual equipment) and this can mostly be attributed to poor product design (care needs to be exercised when measuring “smart” products to ensure that off mode consumption is actually obtained).
- An increase in home computers and associated peripheral equipment coupled with the increase of home offices present a potential area of concern in terms of standby and off mode power usage.
- Audio and visual equipment (other than TVs and VCRs) are also an area for concern due to the large number per household and very poor off and standby performance of such appliances.
- While decreases in standby power were noted for TVs and VCRs (as compared to historical data), there is still room for improvement from these appliance types.
- Improvements in available technology such as integrated circuit switched mode power supplies means that there are now technical options to reduce standby consumption to very low levels for many appliance types. Policies need to be developed to bring new technology onto the market as soon as possible.

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## Appendix A: Telephone survey instrument

### Standby Power Study

#### *Introduction*

Hi my name is \_\_\_\_\_ from the Wallis Group, could I please speak to a member of your household who is 18 years or older. We are doing a survey on the types of appliances you have in your house and how you use them.

*If necessary add:*

The study is being conducted for the Australian Greenhouse Office who are a Federal Government Agency that works with the Department of Environment.

Would you be interested in participating in the survey?

*If necessary add:*

This survey will take up to fifteen minutes of your time.

If yes, continue

If no, thank person for their time.

**Appliance Ownership**

Q-1. Thinking about the appliances in your household, either rented, borrowed or owned, how many of the following do you have? (Insert number)

Television	
Video	
Digital TV receiver	
DVD (digital video disk player)	
Stereo	
Play Station/Game Console	
Microwave	
Coffee Machine	
Electric Kettle	
Bread maker	
Electric Toothbrush (rechargeable only)	
Electric Shaver (rechargeable only)	
Personal Computer	
PC Monitor	
PC Speakers	
Laptop	
Printer	
Fax Machine	
Photo Copier	
Multi-Function Device (Fax/Printer/Copier)	
Answering Machine	
Scanner	
Cordless (Portable) Home Phone	
Mobile Phone	
Smoke detector (mains powered only)	
Clock radio	
Fish tank	
Plug in Air freshener	
Dustbuster	

### Appliance Use

I want to ask you some questions about how you use your appliances. I want you to specifically think about how you used your appliances **yesterday**. (*People are only asked for the appliances that they have, that is, each appliance*)

#### Televisions (Need to ask for each TV)

Q-2. Thinking about your (*insert "first", "second", etc. if necessary*) television, what brand is your Television?

*(Record brand)*

Q-3. And how many hours was your television switched on yesterday?

*(Record hours)*

Q-4. What state is your television in now, is it . . . (*Read 1 to 4*)

TV is on	1
Switched off with the remote	2
Switched off at the TV unit (power switch)	3
Switched off at the TV unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	4
Other (specify)	5
Don't know	9

If TV is on ask:

Q-5. Which of the following is the normal way you would switch off your Television?

Switched off with the remote	1
Switched off at the TV unit (power switch)	2
Switched off at the TV unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	3
Other (specify)	4
Don't know	9

Q-6. Do you remember the year in which you purchased your TV?

*(Record year – 9999=Don't know)*

**VCRs (Need to ask for each VCR)**

Q-7. Thinking about your (*insert "first", "second", etc. if necessary*) VCR, what brand is your VCR?

**(Record brand)**

Q-8. And how many hours was your VCR switched on yesterday?

**(Record hours)**

Q-9. What state is your VCR in now, is it . . . (*Read 1 to 4*)

VCR is on	1
Switched off with the remote	2
Switched off at the VCR unit (power switch)	3
Switched off at the VCR unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	4
Other (specify)	5
Don't know	9

If VCR is on ask:

Q-10. Which of the following is the normal way you would switch off your VCR?

Switched off with the remote	1
Switched off at the VCR unit (power switch)	2
Switched off at the VCR unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	3
Other (specify)	4
Don't know	9

Q-11. Do you remember the year in which you purchased your VCR?

**(Record year – 9999=Don't know)**

**DVDs (Need to ask for each DVD)**

Q-12. Thinking about your (*insert "first", "second", etc. if necessary*) DVD, what brand is your DVD?

*(Record brand)*

Q-13. And how many hours was your DVD switched on yesterday?

*(Record hours)*

Q-14. What state is your DVD in now, is it . . . (*Read 1 to 4*)

DVD is on	1
Switched off with the remote	2
Switched off at the DVD unit (power switch)	3
Switched off at the DVD unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	4
Other (specify)	5
Don't know	9

If DVD is on ask:

Q-15. Which of the following is the normal way you would switch off your DVD?

Switched off with the remote	1
Switched off at the DVD unit (power switch)	2
Switched off at the DVD unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	3
Other (specify)	4
Don't know	9

Q-16. Do you remember the year in which you purchased your DVD?

*(Record year – 9999=Don't know)*

**Stereos (Need to ask for each Stereo)**

Q-17. Thinking about your (*insert "first", "second", etc. if necessary*) Stereo, what brand is your Stereo?

*(Record brand)*

Q-18. Is your stereo an integrated stereo unit or is it made up of separate components such as a CD player, amplifier, tuner or tape deck?

Integrated Unit	1
Separate Components	2
Don't know/Unsure	

Q-19. And how many hours was your Stereo switched on yesterday?

*(Record hours)*

Q-20. What state is your Stereo in now, is it . . . (*Read 1 to 4*)

Stereo is on	1
Switched off with the remote	2
Switched off at the Stereo unit (power switch)	3
Switched off at the Stereo unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	4
Other (specify)	5
Don't know	9

If Stereo is on ask:

Q-21. Which of the following is the normal way you would switch off your Stereo?

Switched off with the remote	1
Switched off at the Stereo unit (power switch)	2
Switched off at the Stereo unit <b>and</b> unplugged at the wall ( <i>may need to probe to check that this is actually what they did/do</i> )	3
Other (specify)	4
Don't know	9

Q-22. Do you remember the year in which you purchased your Stereo?

*(Record year – 9999=Don't know)*

**Microwaves (Need to ask for each Microwave)**

Q-23. What brand is your microwave?

*(Record brand)*

Q-24. Does your microwave normally show the time when on?

Yes	1
No	2
Don't know/Unsure	9

Q-25. What is the status of your microwave now, is it . . . *(Read 1 and 2)*

On but not performing any function (other than clock)	1
Switched off at the wall switch and/or unplugged	2
Other (specify)	3
Don't know	9

Q-26. Do you remember the year in which you purchased your Microwave?

*(Record year – 9999=Don't know)*

**Bread Makers (Need to ask for each Bread Maker)**

Q-27. What brand is your Bread Maker?

*(Record brand)*

Q-28. How many loaves of bread did you make yesterday?

*(Record number)*

Q-29. How many loaves a week would you make with your bread maker?

*(Record number)*

Q-30. Do you normally start it immediately or program it to finish making the loaf at a later time (delayed start)?

Start immediately	1
Delay start	2

Q-31. What is the status of your Bread Maker now, is it . . . *(Read 1 and 2)*

On but not performing any function (other than display)	1
Switched off at the wall switch and/or unplugged	2
Other (specify)	3
Don't know	9

Q-32. Do you remember the year in which you purchased your Bread Maker?

*(Record year – 9999=Don't know)*

**Coffee Machines (Need to ask for each Coffee Machine)**

Q-33. What brand is your Coffee Machine?

*(Record brand)*

Q-34. How cups of coffee did you make yesterday?

*(Record number)*

Q-35. What is the status of your Coffee Machine now, is it . . . *(Read 1 and 2)*

On but not performing any function (other than display)	1
Switched off at the wall switch and/or unplugged	2
Other (specify)	3
Don't know	9

Q-36. Do you remember the year in which you purchased your Coffee Machine?

*(Record year – 9999=Don't know)*

**Electric Kettle (Need to ask for each Electric Kettle)**

Q-37. What brand is your Electric Kettle?

*(Record brand)*

Q-38. How cups of water did you boil yesterday?

*(Record number)*

Q-39. Do you remember the year in which you purchased your Electric Kettle?

*(Record year – 9999=Don't know)*

**Electric Toothbrushes (Need to ask for each Electric Toothbrush)**

Q-40. What brand is your Electric Toothbrush?

*(Record brand)*

Q-41. Is the base station of your electric toothbrush normally plugged in and switched on?

Yes	1
No	2
Don't know	9

Q-42. Do you remember the year in which you purchased your Electric Toothbrush?

*(Record year – 9999=Don't know)*

**Electric Shavers (Need to ask for each Electric Shaver)**

Q-43. What brand is your Electric Shaver?

*(Record brand)*

Q-44. Is the base station of your Electric Shaver normally plugged in and switched on?

Yes	1
No	2
Don't know	9

Q-45. Do you remember the year in which you purchased your Electric Shaver?

*(Record year – 9999=Don't know)*

**Personal Computers (Need to ask for each Personal Computer)**

Q-46. Thinking about your Personal Computer, how many hours was it on for yesterday?

*(Record number)*

Q-47. Is it used by someone who works from home three or more days per week?

Yes	1
No	2
Don't know	

Q-48. Is the computer a laptop or a desk computer?

Laptop	1
Desktop	2
Don't know	9

Q-49. Do you remember the year in which you purchased your computer?

*(Record year – 9999=Don't know)*

**Printers (Need to ask for each Printer)**

Q-50. Thinking about your Printer, how many hours was it on for yesterday?

*(Record number)*

Q-51. What sort of printer do you have?

Laser Printer	1
Bubble-jet printer	2
Other	
Don't know	9

Q-52. Do you remember the year in which you purchased your printer?

*(Record year – 9999=Don't know)*

**Fax Machines (Need to ask for each Fax Machine)**

Q-53. What brand is your Fax Machine?

*(Record brand)*

Q-54. Do you normally . . .

Leave the fax machine on so it is able to receive faxes, or	1
Turn it on only when it is required	2
Don't know	

Q-55. Do you remember the year in which you purchased your Fax Machine?

*(Record year – 9999=Don't know)*

**Photo Copiers (Need to ask for each Photo Copier)**

Q-56. What brand is your Photo Copier?

*(Record brand)*

Q-57. Do you normally . . .

Leave the Photo Copier on, or	1
Turn it off at the machine, or	2
Turn it off at the switch at the wall	3
Don't know	9

Q-58. Do you remember the year in which you purchased your Photo Copier?

*(Record year – 9999=Don't know)*

**Multi-function Devices (Need to ask for each Multi-function Device)**

Q-59. What brand is your Multi-function Device?

*(Record brand)*

Q-60. Do you normally . . .

Leave the Multi-function Device on so it is able to receive faxes, or	1
Turn it on only when it is required	2
Don't know	9

Q-61. Do you remember the year in which you purchased your Multi-function Device?

*(Record year – 9999=Don't know)*

**Scanners (Need to ask for each Scanner)**

Q-62. What brand is your Scanner?

*(Record brand)*

Q-62B Do you normally:

Leave the scanner on, or	1
Turn it on only when it is required	2
Don't know	9

Q-63. Do you remember the year in which you purchased your Scanner?

*(Record year – 9999=Don't know)*

**Mobile Phones (Need to ask for each Mobile Phone)**

Q-64. What brand is your Mobile Phone?

*(Record brand)*

Q-65. Thinking about your Mobile Phone battery charger, do you normally . . .

Leave the battery charger plugged in at the wall, or	1
Unplug it when the phone is not charging	2
Don't know	9

Q-66. Do you remember the year in which you purchased your mobile phone?

*(Record year – 9999=Don't know)*

**Demographics**

Q-67. What sort of dwelling are you living in, is it:

A separate house	1
A semi-detached house, such as a terrace house or townhouse	2
A flat, unit or apartment	3
Other	4

Q-68. How would you describe your family type, are you?

A Couple with children	1
A Couple without children:	2
One parent family:	3
Other family	4
A Group household member	5
Single person	6

Q-69. How many people live in your household?

One	1
Two	2
Three	3
Four	4
Five	5
Six or more	6

Q-70. Please indicate which household ownership category applies to you

House is fully owned	1
House is being purchased	2
House is rented	3
Other	4

Q-71. In what age group are you?

18 to 24	1
25 to 34	2
35 to 44	3
45 to 54	4
55 to 64	5
65 or over	6

Q-72. In what broad category is your household income? (***The total gross income of all residents***)

Less than \$30,000 per annum	1
\$30,000 to less than \$50,000	2
\$50,000 to \$80,000	3
More than \$80,000	4
Do not wish to respond	
Don't Know	9

***Thank participant for their cooperation.***

## Appendix B: Demographics of Appliance Use and Intrusive Surveys

Figure 39 - Type of Dwelling

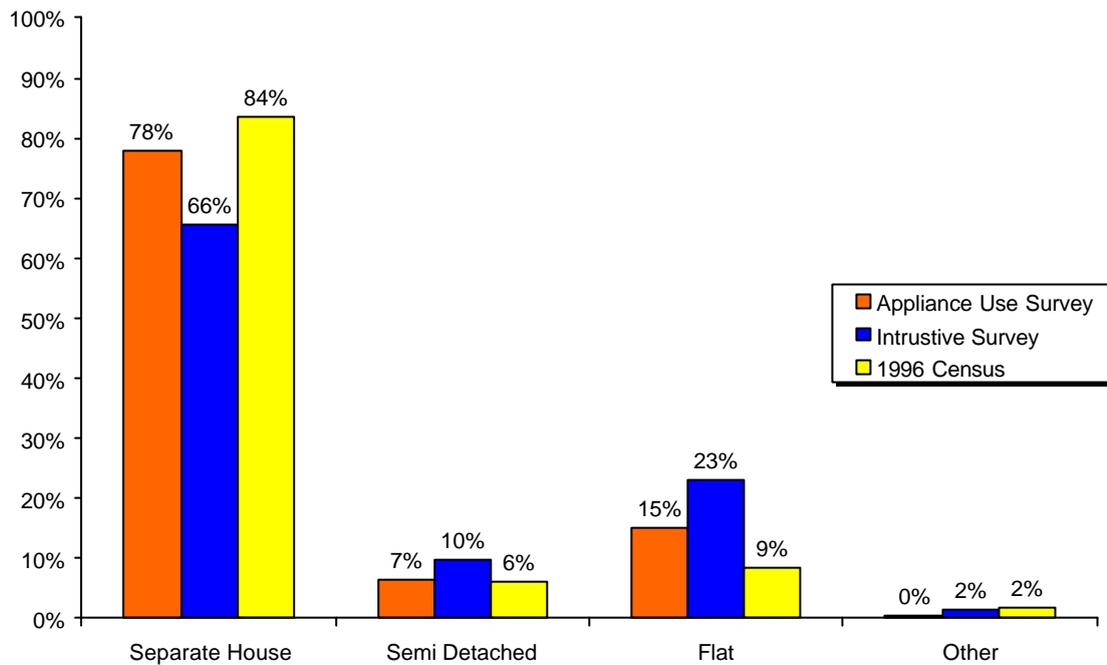


Figure 40 - Household Ownership

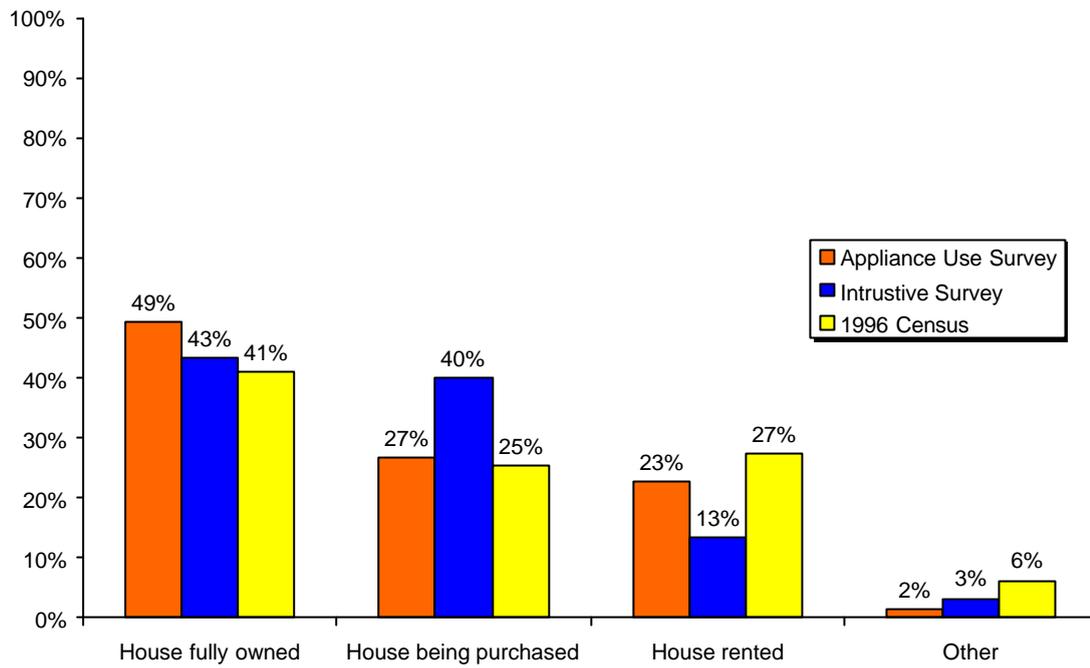


Figure 41 - Family Type

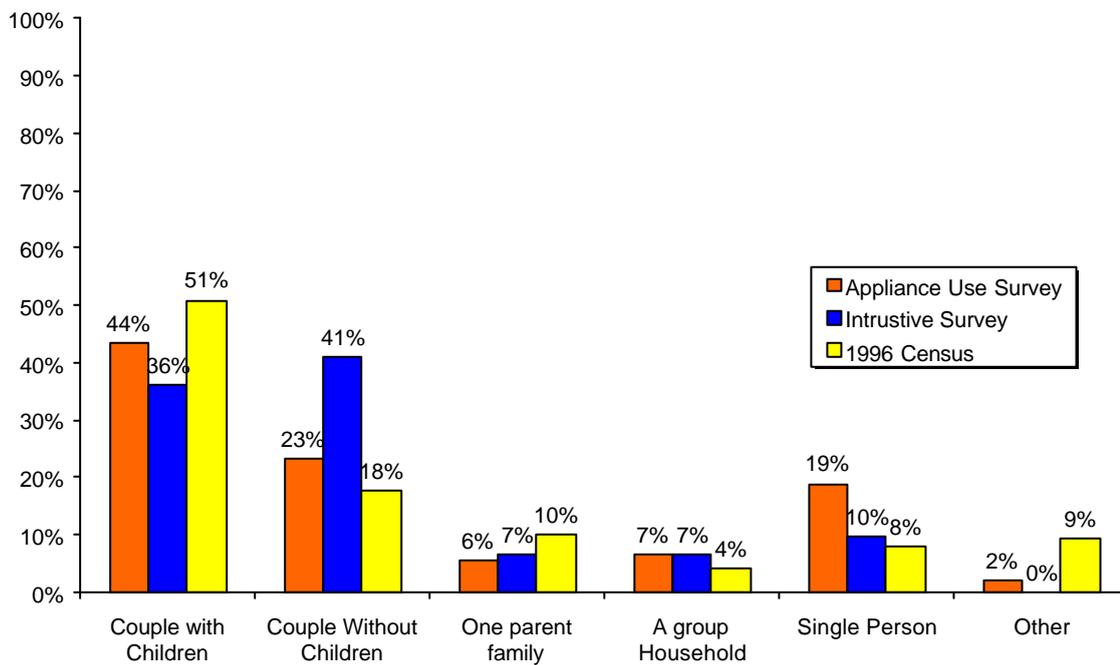


Figure 42 - Number of Occupants in Household

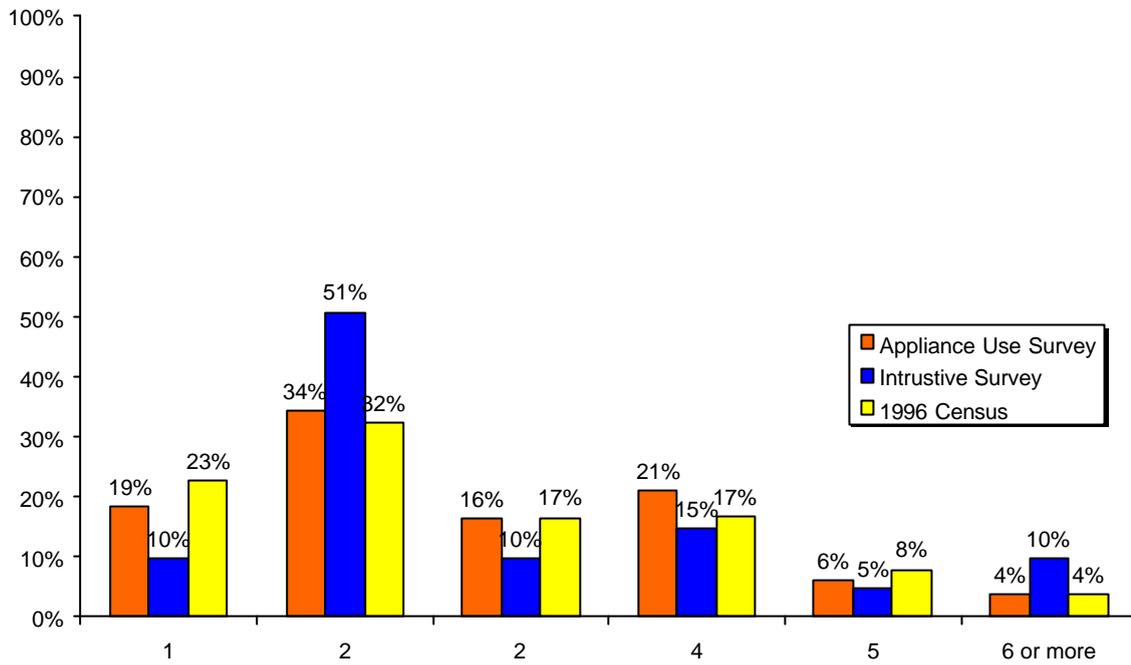
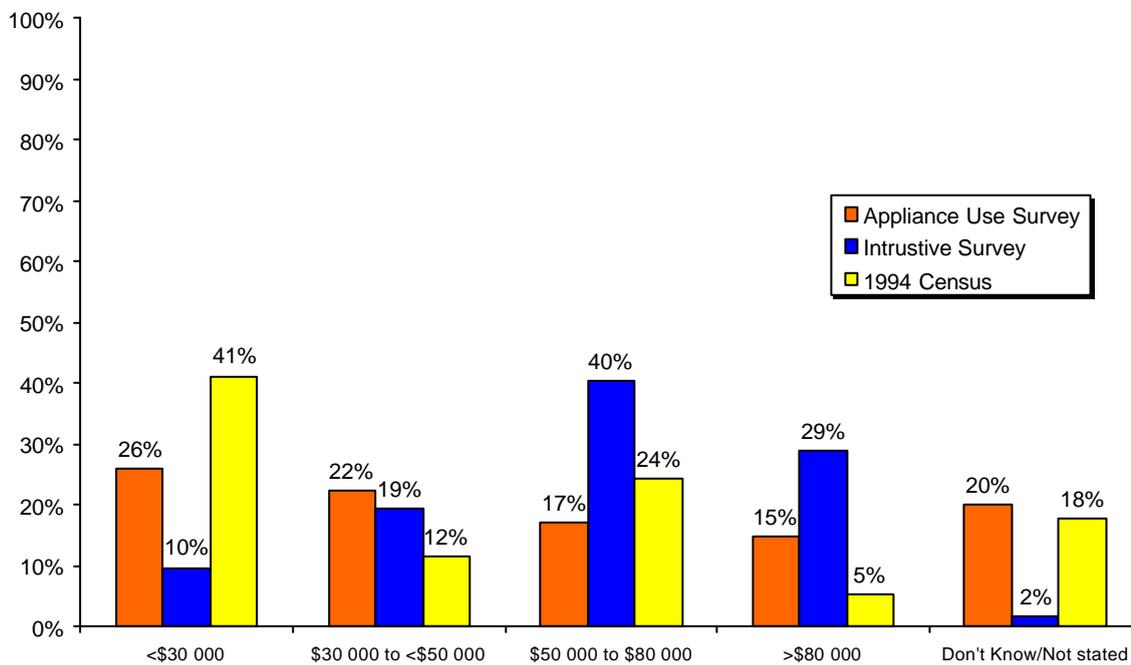


Figure 43 - Annual Household Income



## Appendix C: Intrusive Survey: Appliance Categories and Appliance Types

Table 6: Intrusive Survey: Product Categories

Group	Group title
1	Clothes washers
2	Clothes dryers
3	Dishwashers
4	Air conditioners
5	Space heaters
6	Refrigerators
7	Freezers
8	Cookers
9	Ovens
10	Ranges
11	TV
12	VCR
13	Small appliances
14	Other audio & visual
15	Computers, peripherals, office equipment
16	Transformers & battery operated appliances
17	Monitoring and continuous appliances
18	Miscellaneous appliances
19	Water heaters

Table 7: Intrusive Survey – Complete List of Measured Product Types

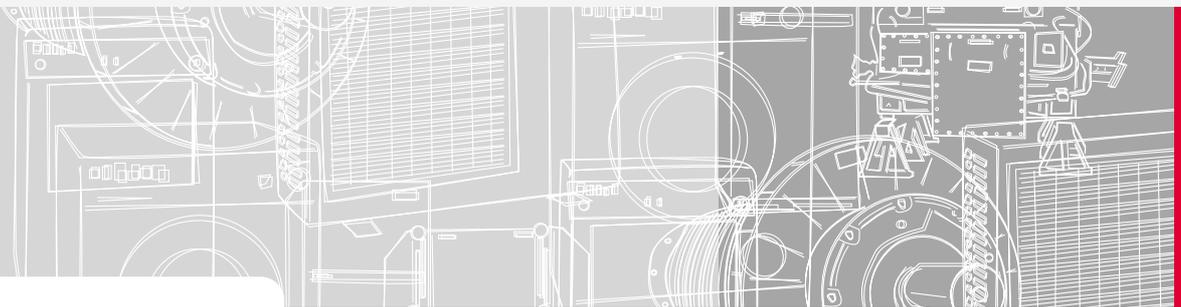
Code	Group	Product
1002	14	Integrated cassette
1003	14	Integrated cd player
1004	14	Integrated tuner
1005	16	Video Camera battery
1006	16	AC Adaptor
1007	16	AC Adaptor for water fountain
1008	16	Adaptor
1009	16	Adaptor for Battery Charger
1010	18	Aerial
1011	18	Air filter
1012	18	Air freshener
1013	4	Airconditioner
1014	17	Alarm
1015	14	Amp/tuner
1016	14	Amplifier
1017	17	Answering Machine
1018	18	Aromatherapy
1019	16	Battery Charger
1020	18	Benchgrinder
1021	18	Benchsaw
1022	13	Breadmaker
1023	13	Breadslicer

Code	Group	Product
1024	15	Calculator
1025	18	Carving Tool
1026	18	CB Radio
1027	15	CD Burner
1028	14	CD Player
1029	14	CD Player - Portable
1030	15	CD Writer
1031	17	Clock
1032	17	Clock radio
1033	13	Coffee Machine
1034	15	Computer
1035	15	Computer - Monitor
1036	15	Computer - Speakers
1037	16	Contact lens cleaner
1038	16	Cordless drill
1039	15	DDS DA
1040	15	Digital Camera
1041	14	Discman - cd player
1042	14	Discman - tuner
1043	16	Discman charger
1044	3	Dishwasher
1045	17	Doorbell remote chimer
1046	17	Double adaptor
1047	2	Dryer
1048	13	Ducted Vacuum
1049	16	Dustbuster
1050	14	DVD Player
1051	18	Effects Unit - guitar
1052	16	Electric Drill
1053	18	Electric Fence
1054	16	Electric Lawnmower
1055	9	Electric Oven
1056	16	Electric Shaver
1057	16	Electric Toothbrush
1058	15	Electronic Organiser
1059	16	Epilator
1060	14	Equalizer
1061	4	Evaporative Cooler
1062	15	External Hard Drive
1063	13	Fan
1064	13	Fan - Ceiling
1065	13	Fan - floor
1066	17	Fax
1067	17	Fish tank Bubbler
1068	17	Fish tank Filter
1069	17	Fish tank Heater
1070	17	Fish tank Light
1071	17	Fish tank Pump
1072	7	Freezer
1073	15	Game Console
1074	8	Gas Stove
1075	13	Hairdryer
1076	14	Headphones
1077	14	Headphones (infrared cordless)
1078	18	Heated Towel Rail
1079	5	Heater - Convection

Code	Group	Product
1080	5	Heater - Electric Wall
1081	5	Heater - Fan
1082	5	Heater - gas
1083	5	Heater - Oil
1084	5	Heater - Wall
1085	19	Hot Water Heater
1086	19	Hot Water heater - Gas
1087	15	Hub
1088	15	Hub - USB
1089	17	Intercom
1090	13	Iron
1091	13	Ironing Press
1092	17	Irrigation System
1093	15	Joystick
1094	18	Lamp
1095	16	Lamp - Dimmer switch
1096	16	Lamp - Halogen
1097	18	Lamp - touch lamp
1098	15	Laptop
1099	14	Laser Disc Player
1100	18	Lathe
1101	13	Microwave
1102	13	Microwave/Convection
1103	14	Minidisc Player
1104	14	Minidisc Player
1105	16	Mobile Phone charger
1106	15	Modem
1107	15	Multi-Function Device
1108	18	Music - Keyboard
1109	18	Nightlight
1110	9	Oven
1111	9	Oven - electric
1112	9	Oven - gas
1113	10	Oven/Stove
1114	10	Oven/Stove - electric
1115	13	Overlocker
1116	15	Palm Pilot
1117	14	Pay TV - Foxtel
1118	14	Pay TV - Optus
1119	16	Phone - Cordless
1120	15	Photocopier
1121	18	Photographic Enlarger
1122	17	Pond pump
1123	17	Pool Ioniser
1124	17	Power Filter
1125	17	Powerboard
1126	15	Printer
1127	18	Professional Flash Unit
1128	16	Radio Phone Line
1129	18	Radio Scanner
1130	13	Rangehood
1131	16	Rechargeable Shaver
1132	16	Rechargeable Torch
1133	18	Rechargeable Refrigerator
1134	16	Rechargeable WhipperSnipper
1135	14	Record Player

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<b>Code</b>	<b>Group</b>	<b>Product</b>
1136	6	Refrigerator
1137	16	Ride-on toy car
1138	17	Rollerdoor
1139	15	Scanner
1140	17	Sensor Light
1141	13	Sewing Machine
1142	15	Shredder
1143	17	Solar Heating Pool Control
1144	14	Speaker - Subwoofer
1145	14	Speakers
1146	17	Sprinkler System
1147	14	Stereo
1148	14	Stereo - Integrated Unit
1149	14	Stereo - Mixer
1150	14	Stereo - Portable
1151	14	Stereo Mixer
1152	8	Stove
1153	8	Stove - electric
1154	8	Stove - gas
1155	10	Stove/Oven
1156	10	Stove/Oven - electric
1157	10	Stove/Oven - gas
1158	17	Surge guard
1159	14	Tape Deck
1160	18	Teletypewriter
1161	17	Timer
1162	17	Timer - Pool pump and Chlorinator
1163	13	Toaster Oven
1164	16	Transformer
1165	16	Transformer for tree lights
1166	18	Travel Converter
1167	18	Treadmill
1168	14	Tuner
1169	11	TV
1170	11	TV/VCR
1171	12	VCR
1172	18	VCR - Editing Machine
1173	18	Ventilator
1174	16	Video Camera
1175	1	Washing Machine
1176	18	Water cooler
1177	18	Water Feature
1178	18	Water filter
1179	18	Water pump
1180	18	Water softener
1181	18	Waterbed
1182	14	Wireless Microphone
1183	15	Zip Drive



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on the National Appliance and Equipment  
Efficiency Program.